

Advanced Data Analysis (ADA) Solves the Mystery Why Two Challenging Sites have not Met Remedial Goals



William Benni



Advanced Data Analysis (ADA)

ADA is an expert system with specially developed analyses to identify the underlying causes for failure to reach remedial goals.

ADA persists until the a clear set of issues are found.

ADA creates new site-specific analyses if necessary.

ADA will solve the mystery of why your site is not closing.

ADA Assessments renders suggestions to guide reaching goals.

ADA Strategic Solutions uses more analyses if a detailed action list is desired that will maximize the probability of success.



70 Problem Sites Solved in 10 Years

ADA has solved **70 Problem Sites** in 10 States in the past 10 Years

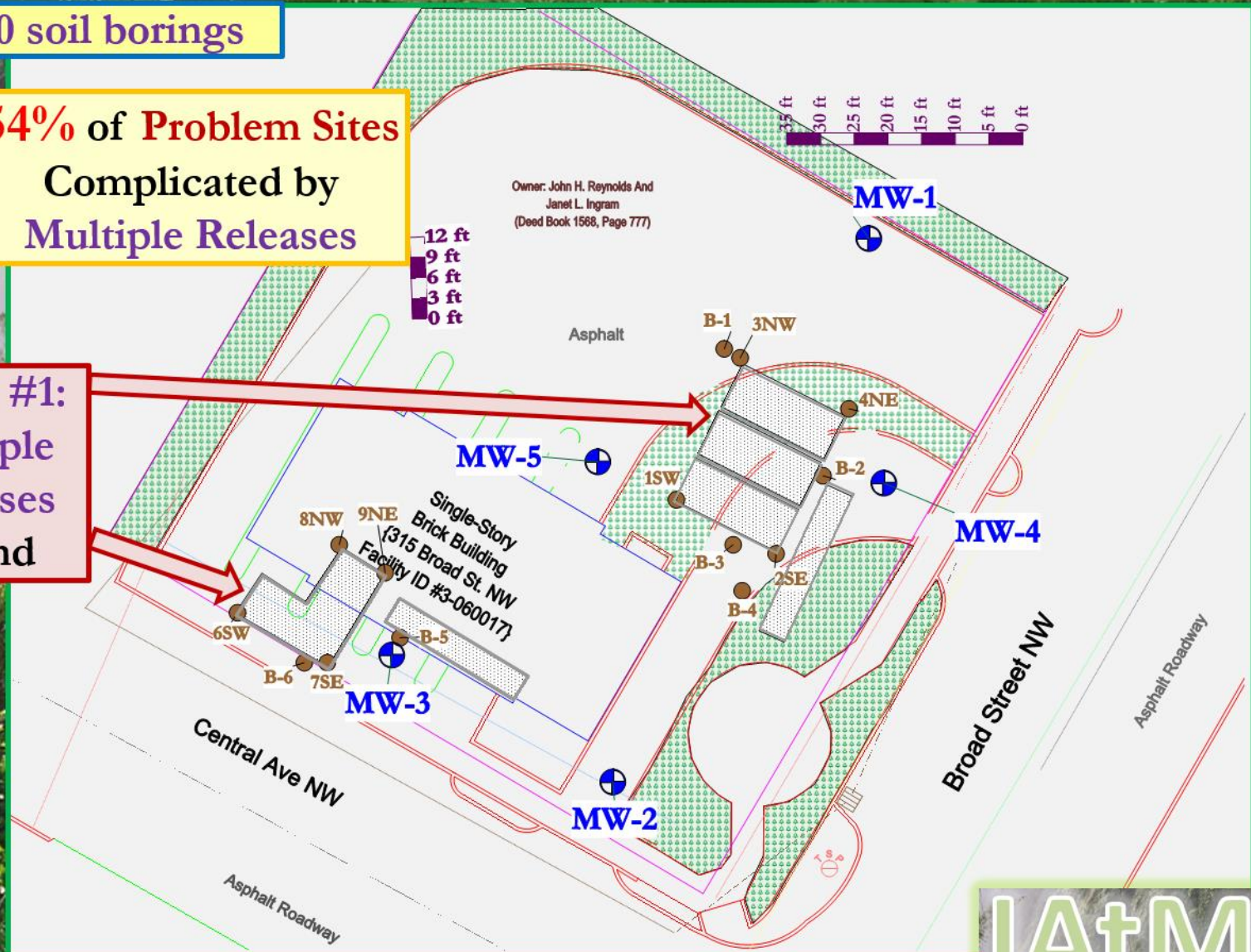
- A review of 282 Sites in Mississippi revealed that 3 out of 10 became **Problem Sites** (4+ years to reach remedial goals)
- Multiplicity of causes (3+) is the primary reason that standard analysis, supplemental investigations including high resolution data, modifying or switching remedies failed.
- Finding the complete combination of issues is required.
- **If your site has not cleaned up in 4 years, ADA is needed.**

Former Bob's Gulf Cleveland, TN (ID# 3-060017)

1993 and 2010 soil borings

**54% of Problem Sites
Complicated by
Multiple Releases**

**Cause #1:
Multiple
Releases
Found**

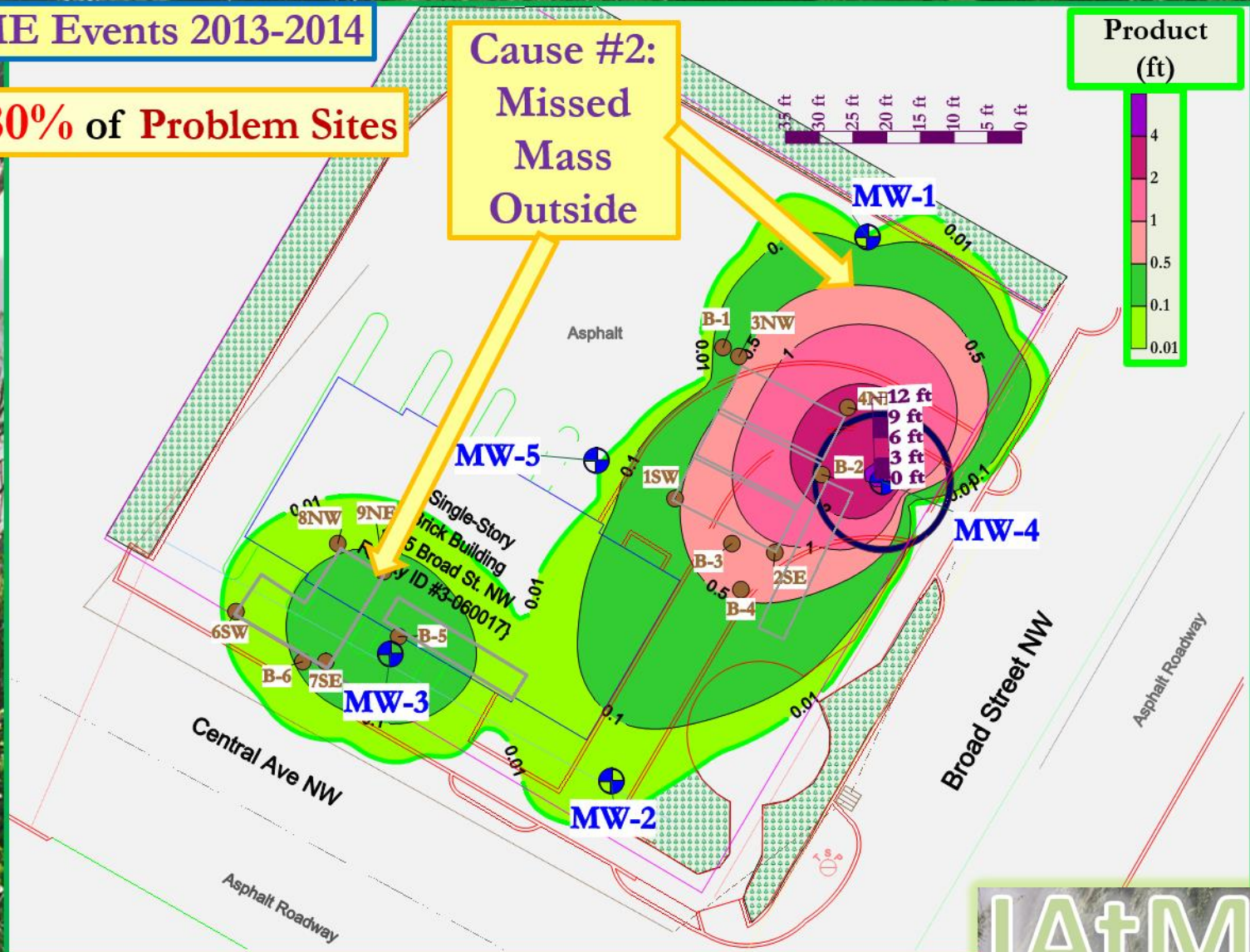


Former Bob's Gulf Cleveland, TN (ID# 3-060017)

5 Initial MEME Events 2013-2014

80% of Problem Sites

Cause #2:
Missed
Mass
Outside



ADA

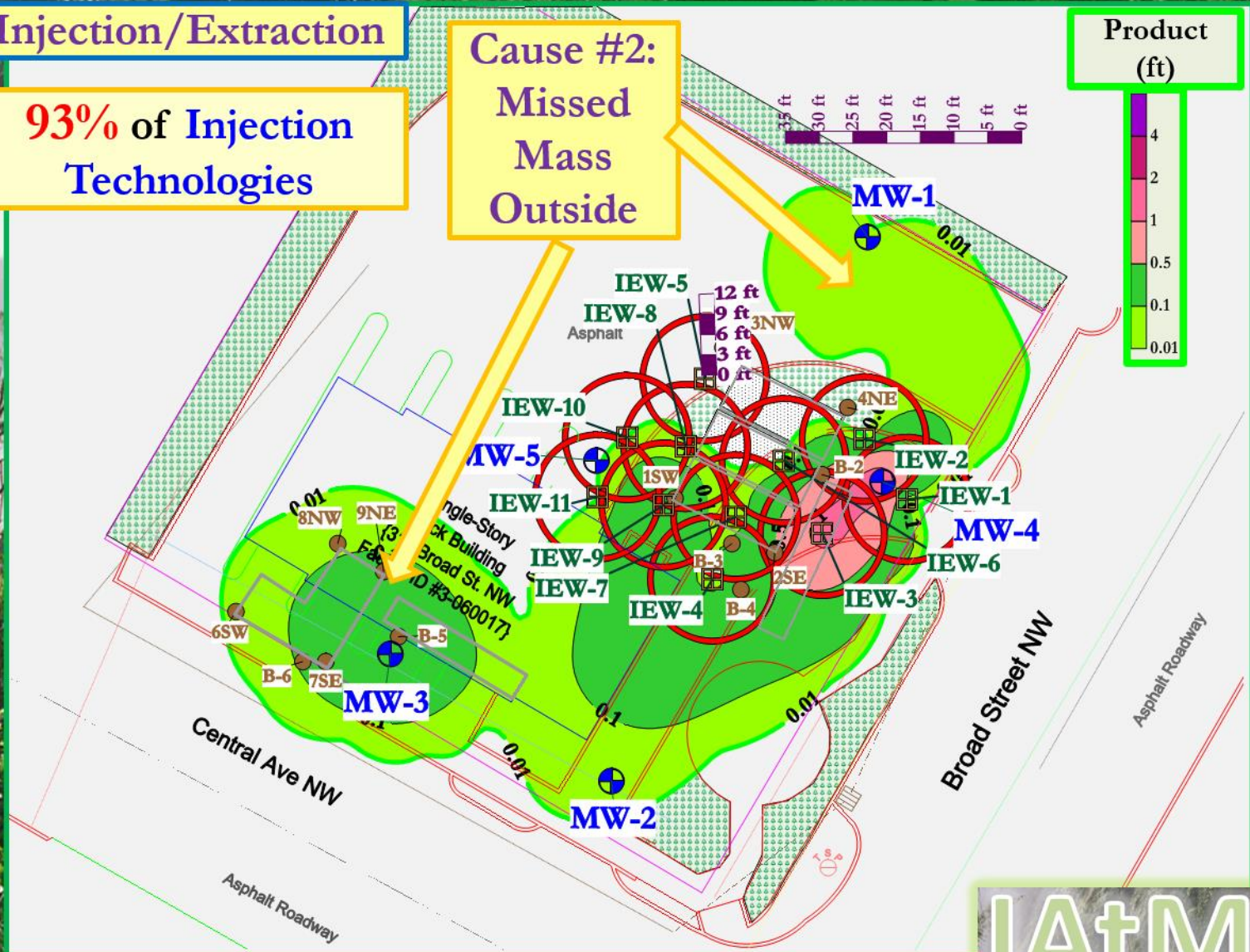
Former Bob's Gulf Cleveland, TN (ID# 3-060017)

2 Rounds of Injection/Extraction

93% of Injection
Technologies

Cause #2:
Missed
Mass
Outside

Product
(ft)

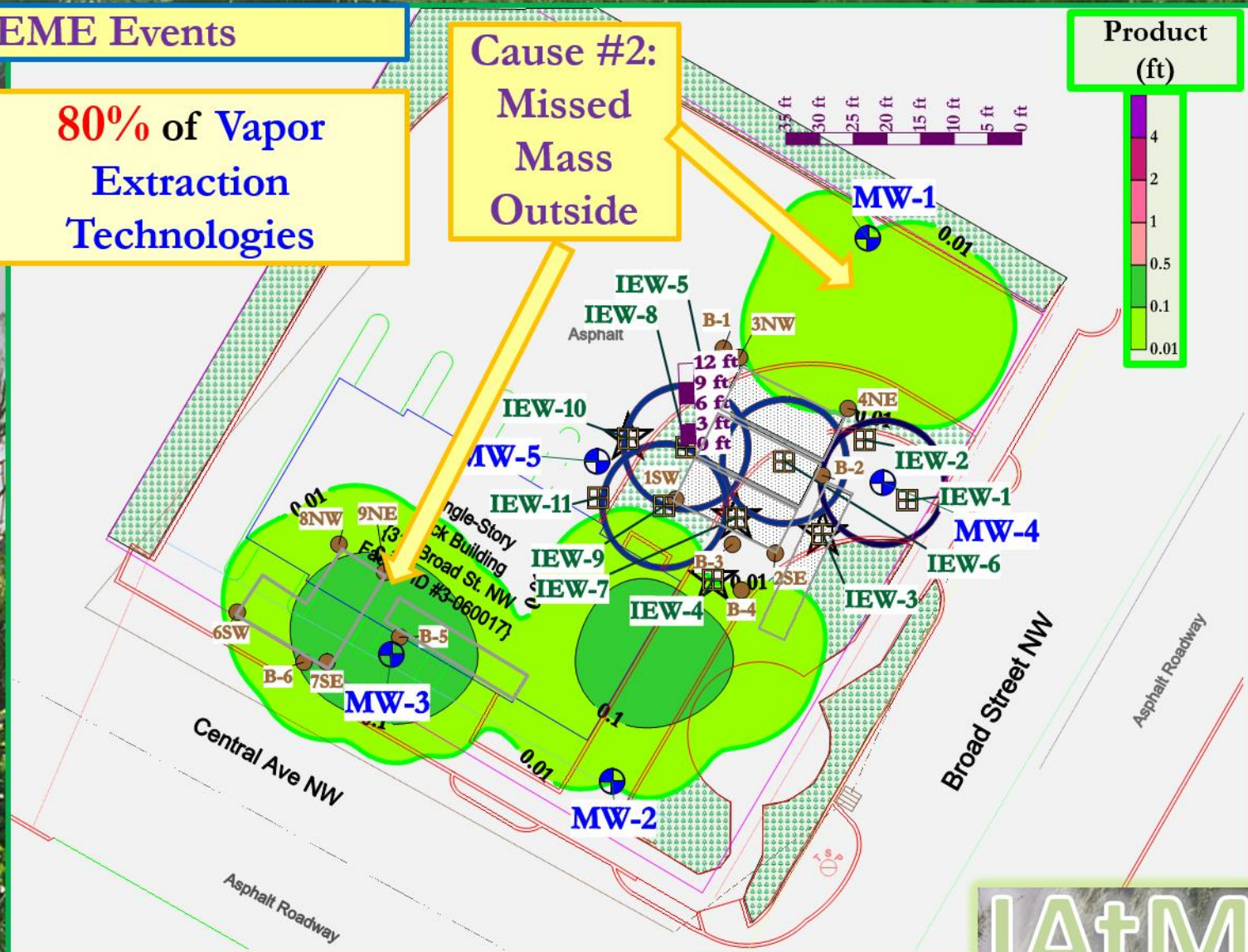


Former Bob's Gulf Cleveland, TN (ID# 3-060017)

24 MEME Events

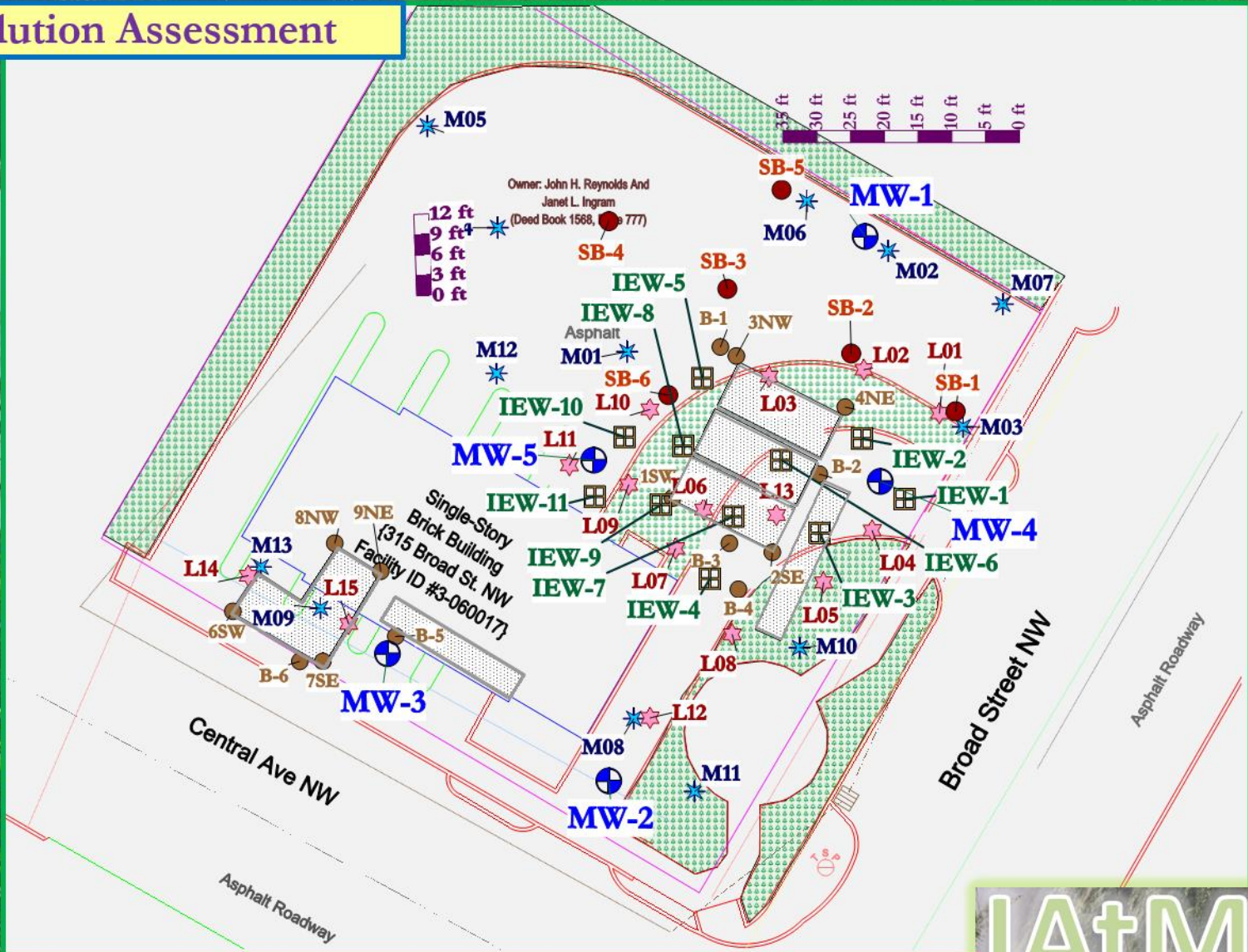
80% of Vapor
Extraction
Technologies

Cause #2:
Missed
Mass
Outside



Former Bob's Gulf Cleveland, TN (ID# 3-060017)

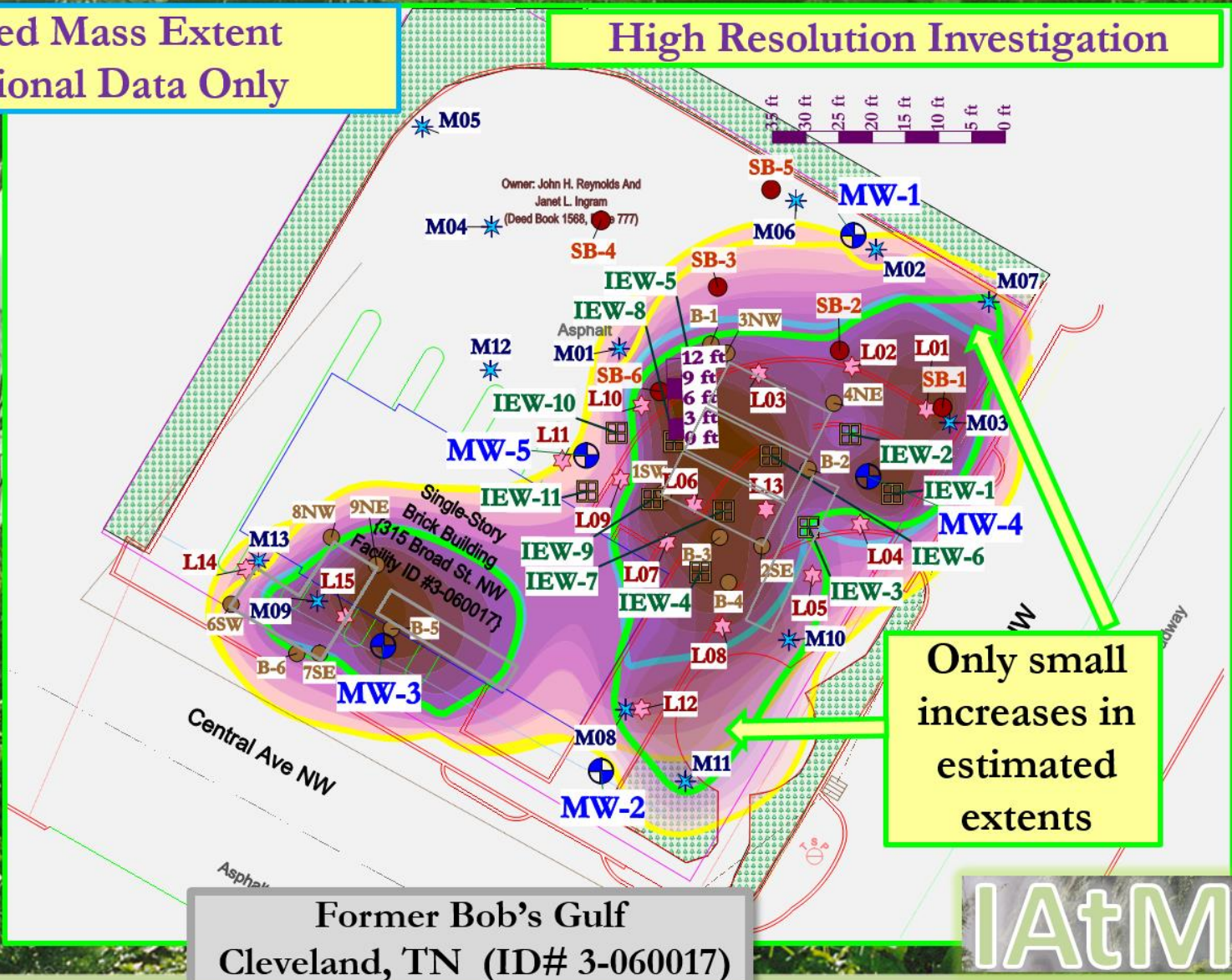
High Resolution Assessment



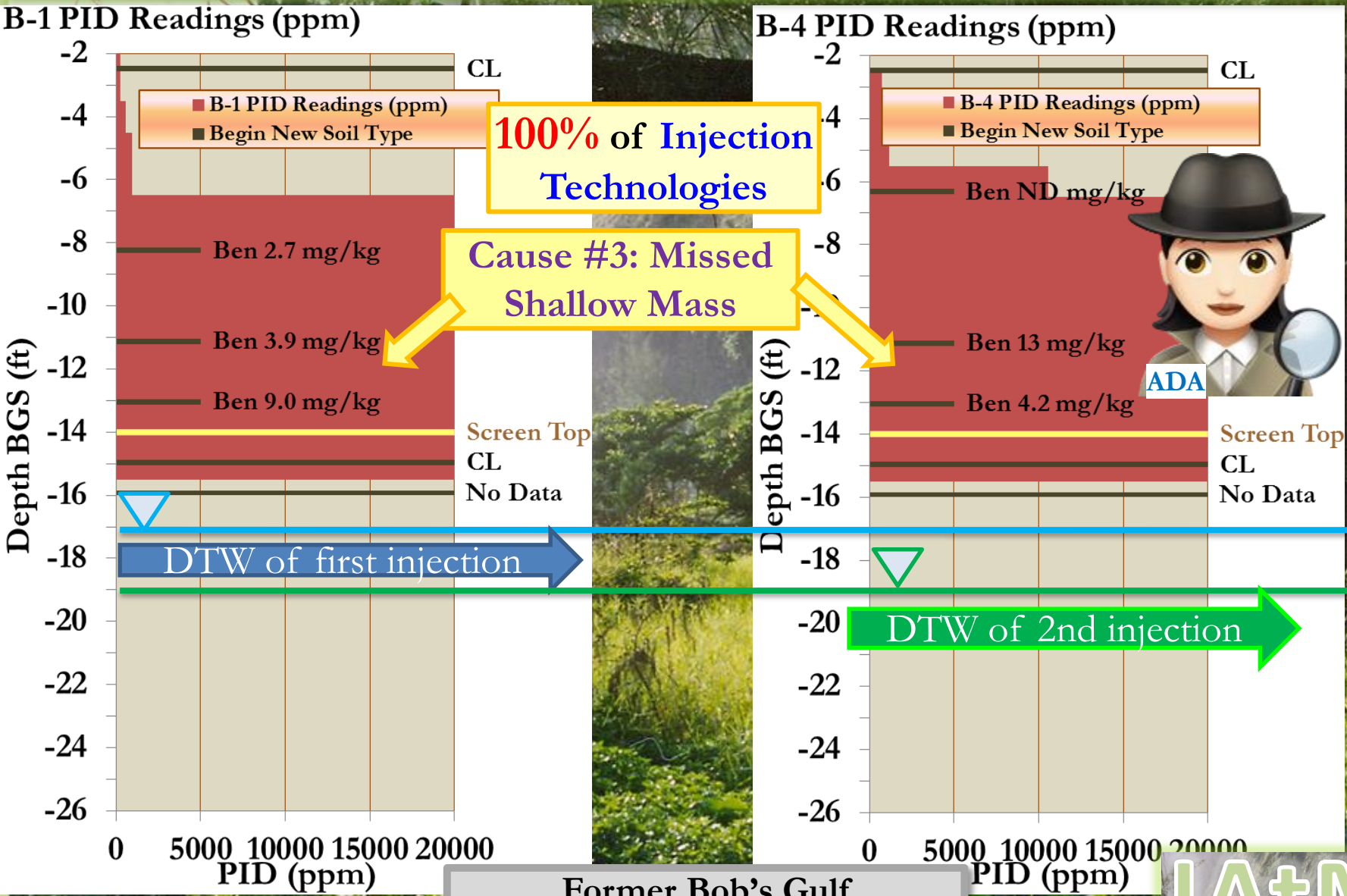
ADA

Estimated Mass Extent Conventional Data Only

Slide 9



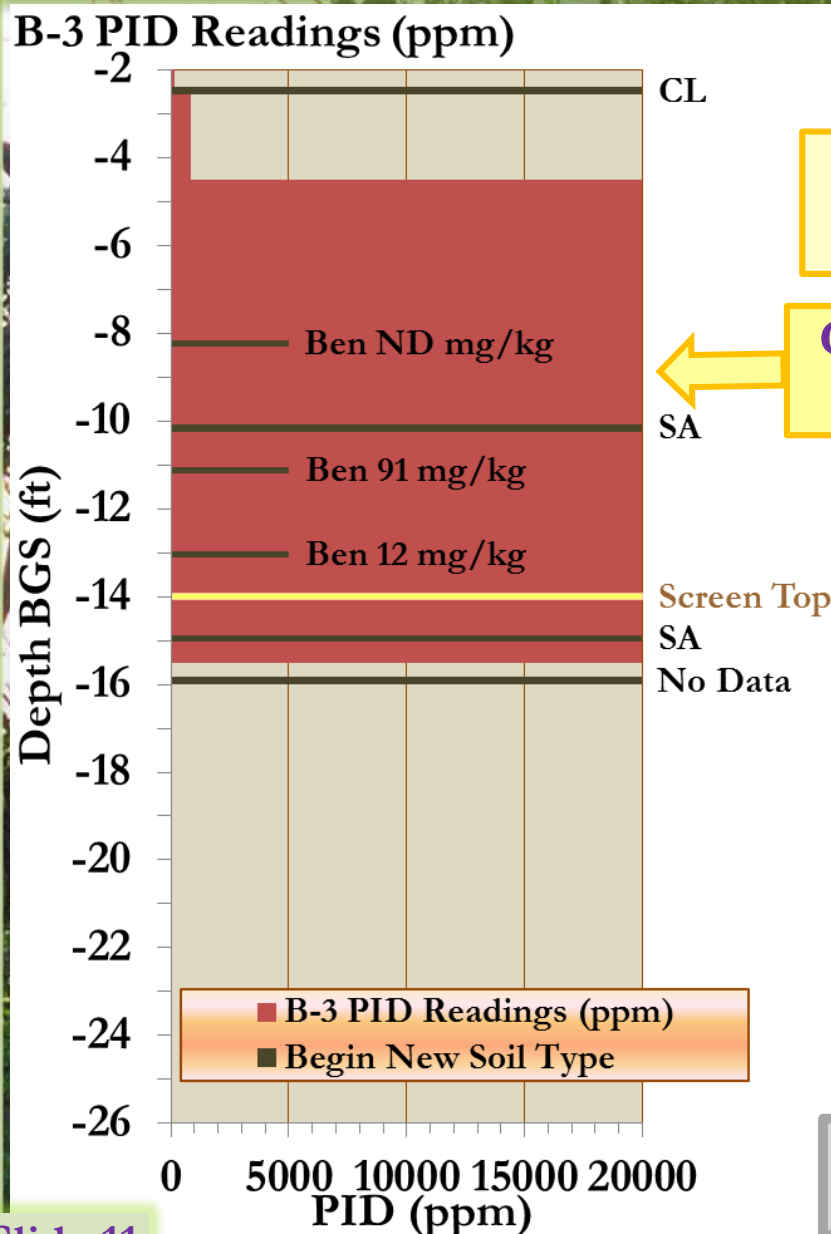
System Efficiency Evaluation (SEE): High Earlier Shallow PIDs in Vadose Zone above DTWs at time Injections Ensures Missed Shallow Mass



Former Bob's Gulf
Cleveland, TN (ID# 3-060017)



SEE: High Earlier Shallow PIDs in Vadose Zone above Top of Well Screen Still Leaves **Missed Shallow Mass** after **24 MEME Events**



18% of Vapor Technologies

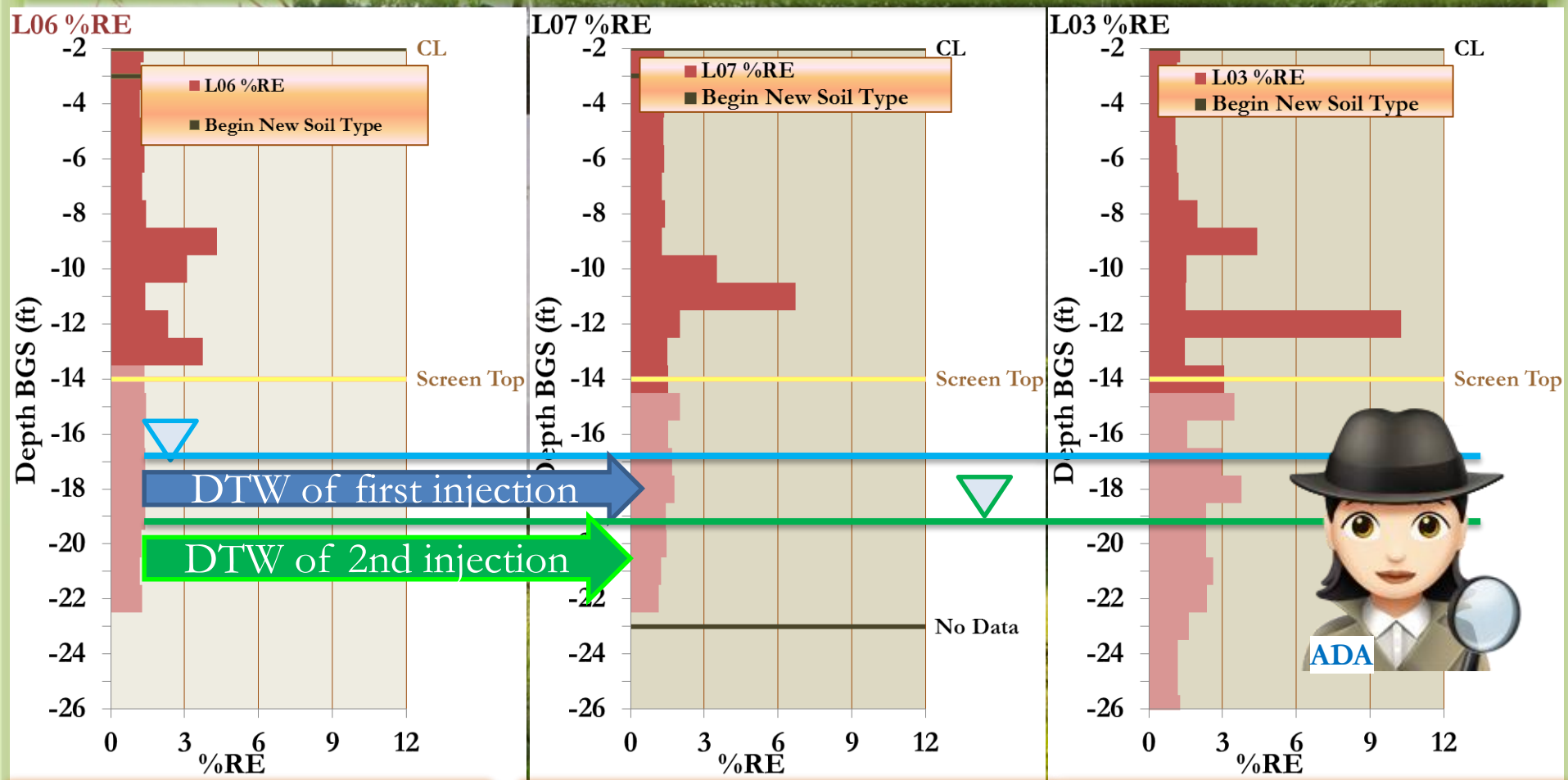
Cause #3: Missed Shallow Mass



Former Bob's Gulf
Cleveland, TN (ID# 3-060017)

IAtM

SEE: High LIF Responses above IEW Screen Tops after Injection and MEME Events Confirmed Ineffectiveness of Both for Reducing Shallow Mass



**Clear Low %RE
Confirm Injection ROI
of Greater than 4 feet**

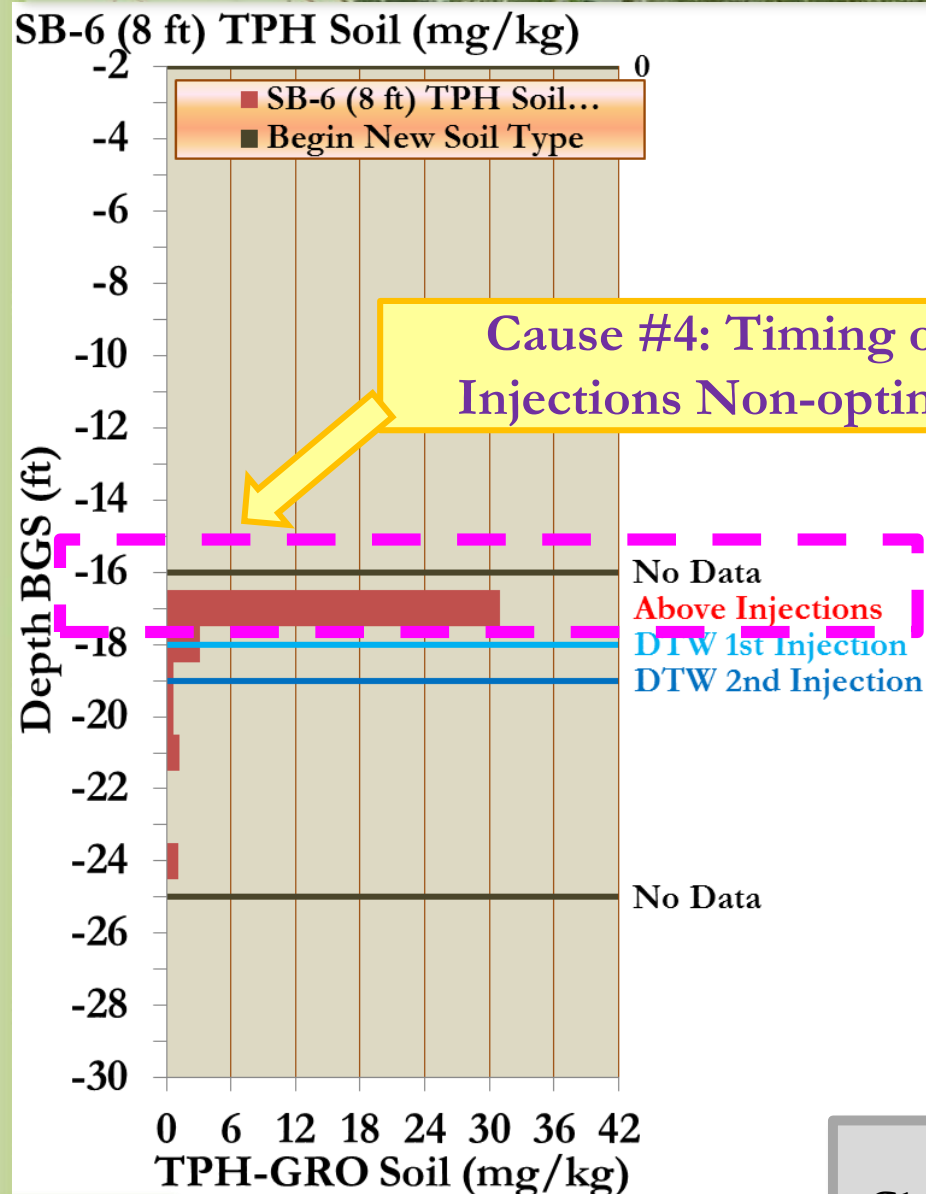
**Not Fully Reduced %RE
at Distance of 7 feet**

**Variable High %RE
ROI of Less than 12 feet**

Former Bob's Gulf
Cleveland, TN (ID# 3-060017)

IAtM

SEE: Timing of Injections Critical: Highest Post-injection Soil Concentrations at or Above DTW of First Injection. Non-optimal Time for Second Injection

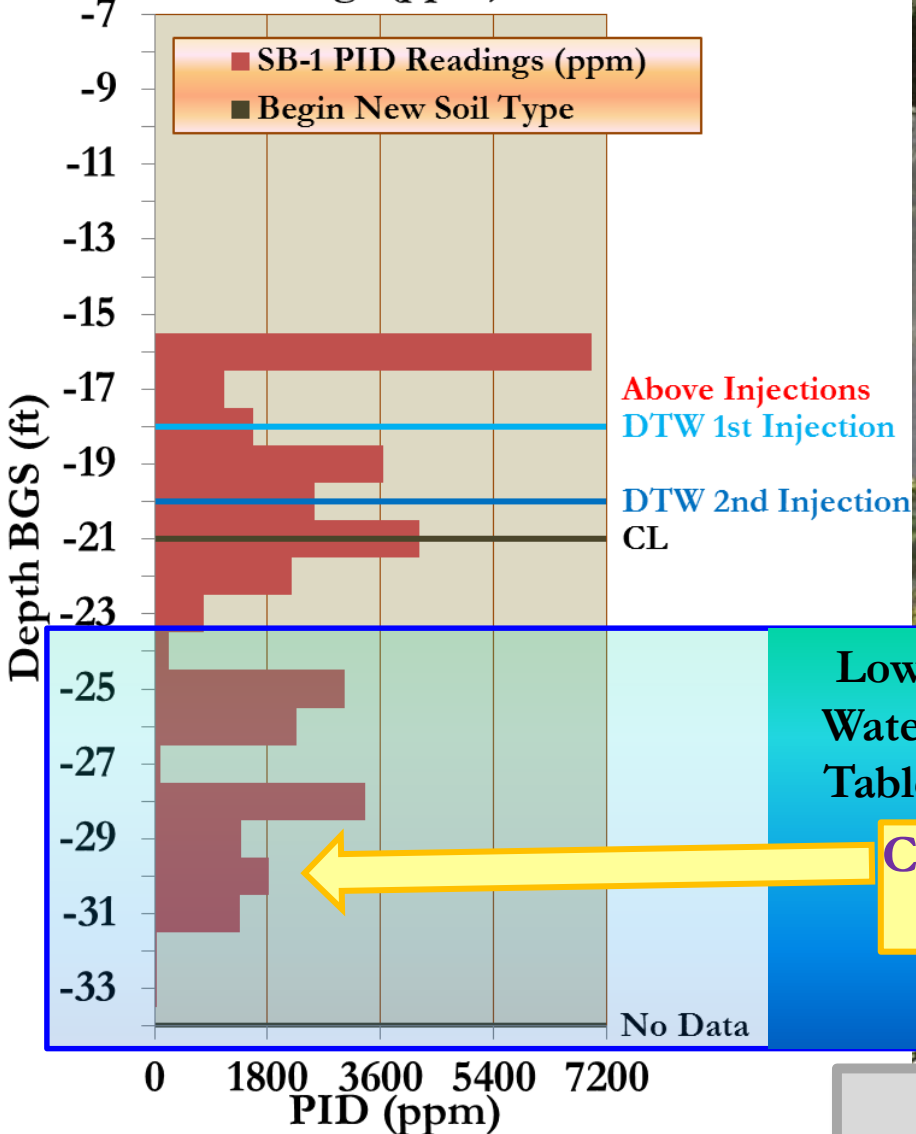


Former Bob's Gulf
Cleveland, TN (ID# 3-060017)

IAtM

SEE: Significant Submerged Mass below Low Water Table Could Undermine Future **MEME** Events or Dedicated **DPE:** More **Injections** Could be Needed

SB-1 PID Readings (ppm)



76% of Vapor Technologies

Cause #5: Missed Deep Submerged Mass



Former Bob's Gulf
Cleveland, TN (ID# 3-060017)

IAtM

Suggestions: Install SVE 4-inch Recovery Wells Down to Water Table and/or Shallow Injections Wells Near Exceeding IEWs with Missed Mass Above

Cause #1: Multiple Releases Found

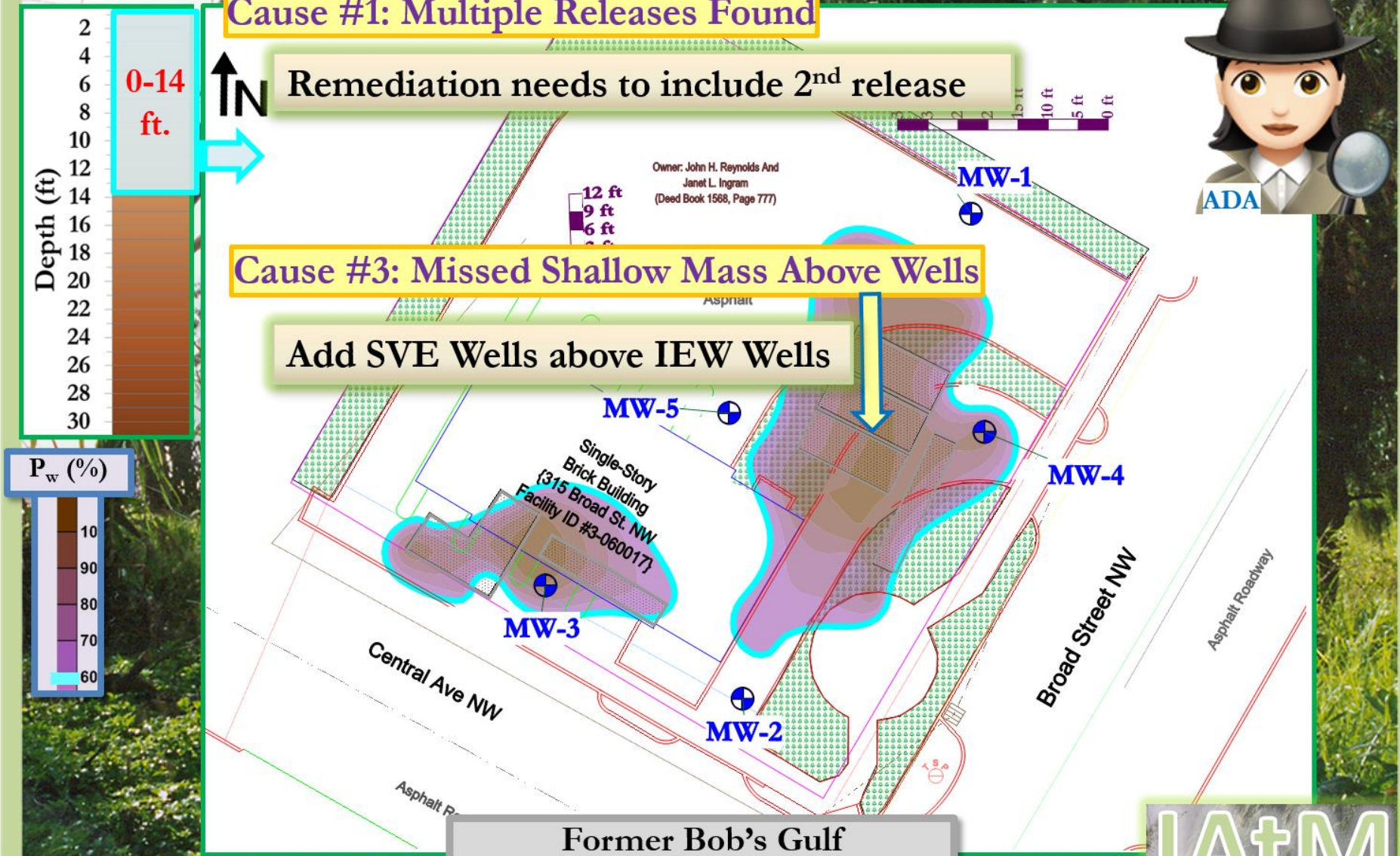
Remediation needs to include 2nd release

Cause #3: Missed Shallow Mass Above Wells

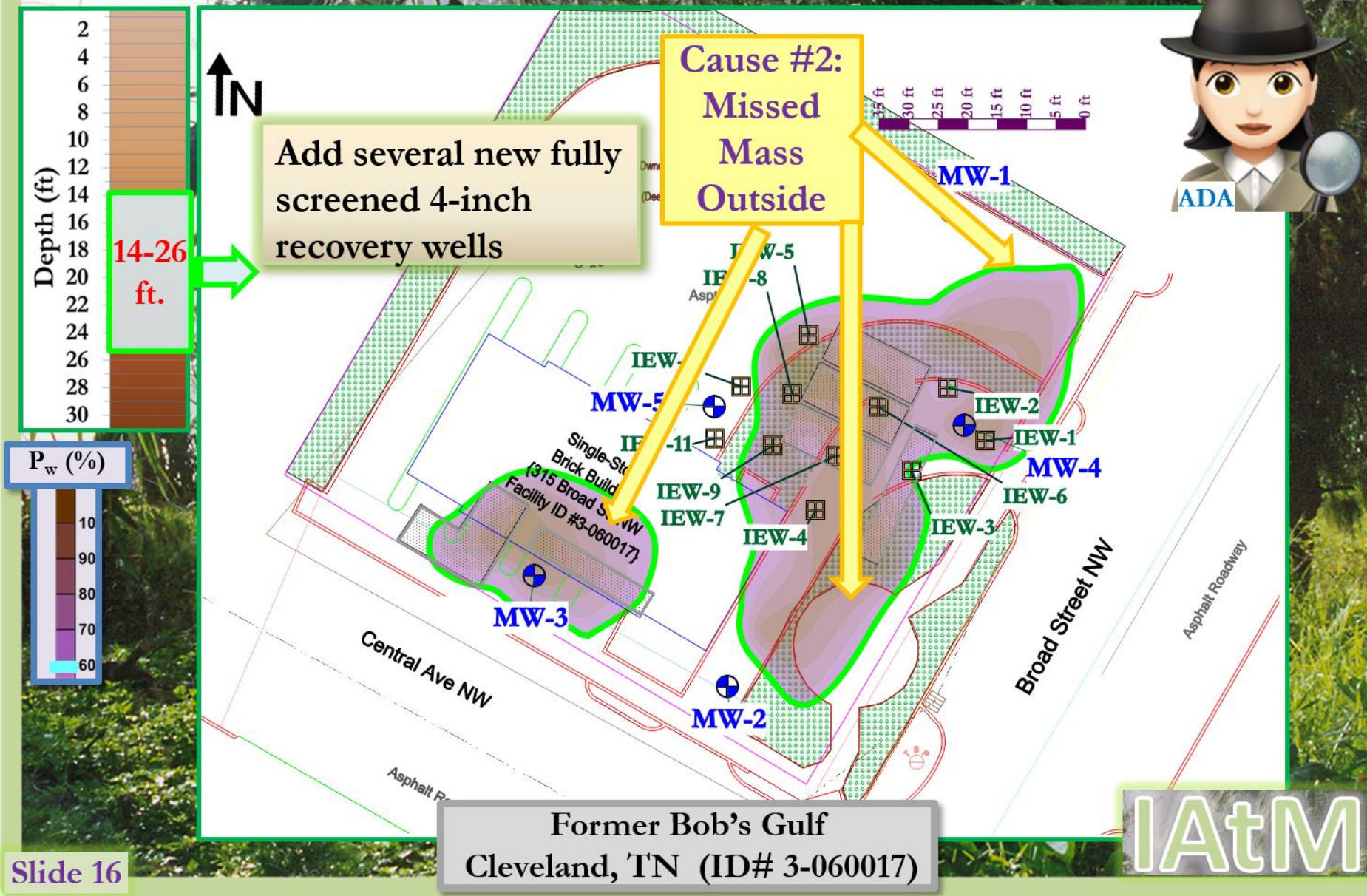
Add SVE Wells above IEW Wells

Former Bob's Gulf
Cleveland, TN (ID# 3-060017)

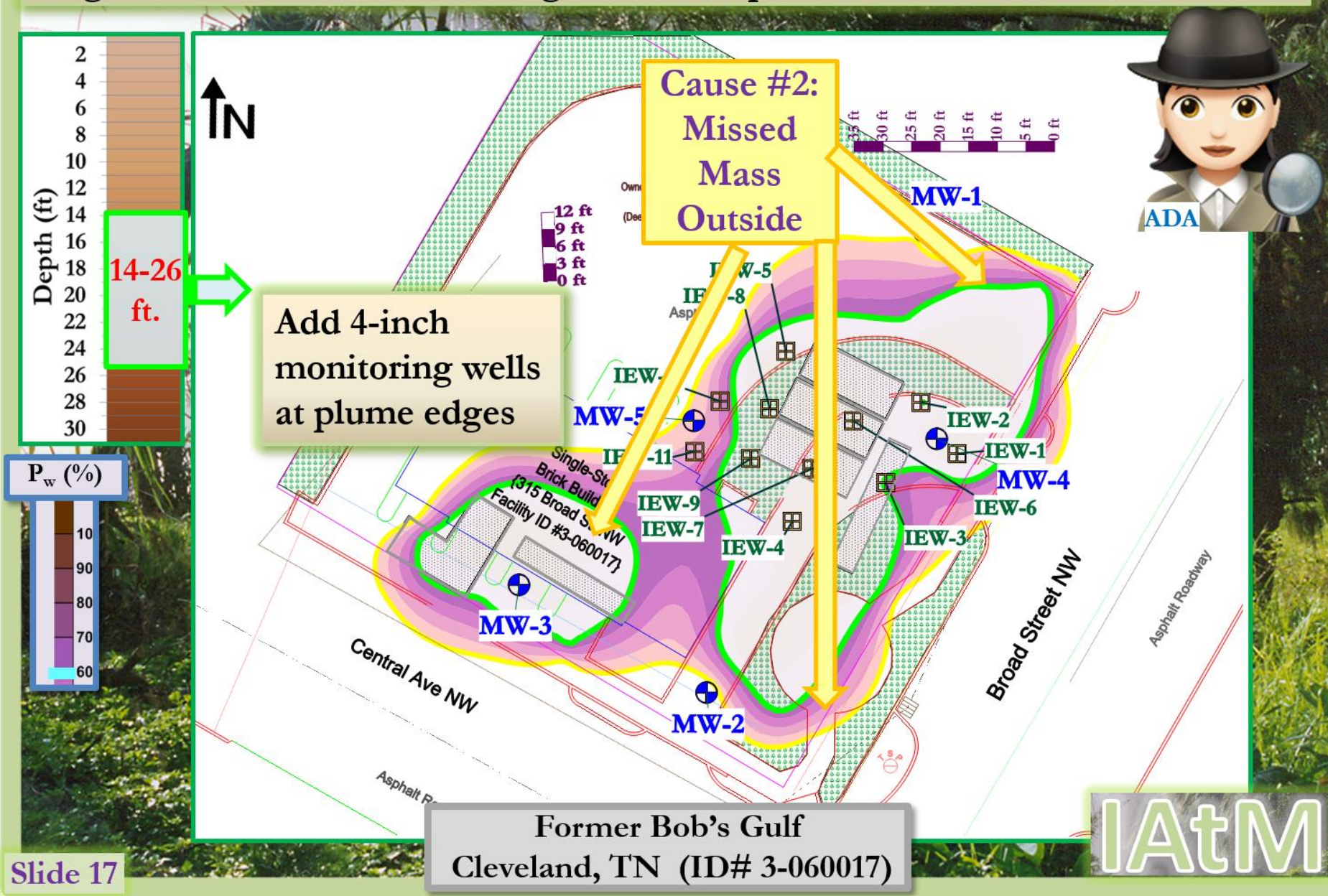
IAtM



Suggestions: Install Several Fully Screened 4-inch Recovery Wells to Serve as Injection, Extraction and Monitoring Points in **Missed Mass Outside**



Suggestions: Install Some Fully Screened 4-inch Monitoring Wells at Plume Edges to Convert Areas with High MIPs Responses to Groundwater Data



Suggestions: Complete a Full Round of Inject/Extract CHEMOX at the Optimal Time that Targets Deep Mass after 1 or 2 rounds of DW Samples

Cause #4: Timing of Injections Non-optimal



Determine optimal time for injections using **ADA Strategic Solutions**



Cause #5: Missed Deep Submerged Mass

Install dedicated deep monitoring wells

Complete full round of inject/extract CHEMOX

Former Bob's Gulf
Cleveland, TN (ID# 3-060017)

IAtM

Depth (ft)

2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

P_w (%)

10
90
80
70
60

26-31
ft.



12 ft
9 ft
6 ft
3 ft
0 ft

Janet L. Ingram
(Deed Book 1568, Page 777)

IEW-5

MW-1

20 ft
15 ft
10 ft
5 ft
0 ft

MW-5
Single-Story
Brick Buil
(315

IEW-11

IEW-2

IEW-1

MW-4

MW-3

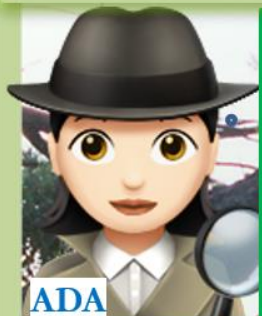
Central Ave NW

MW-2

Broad Street NW

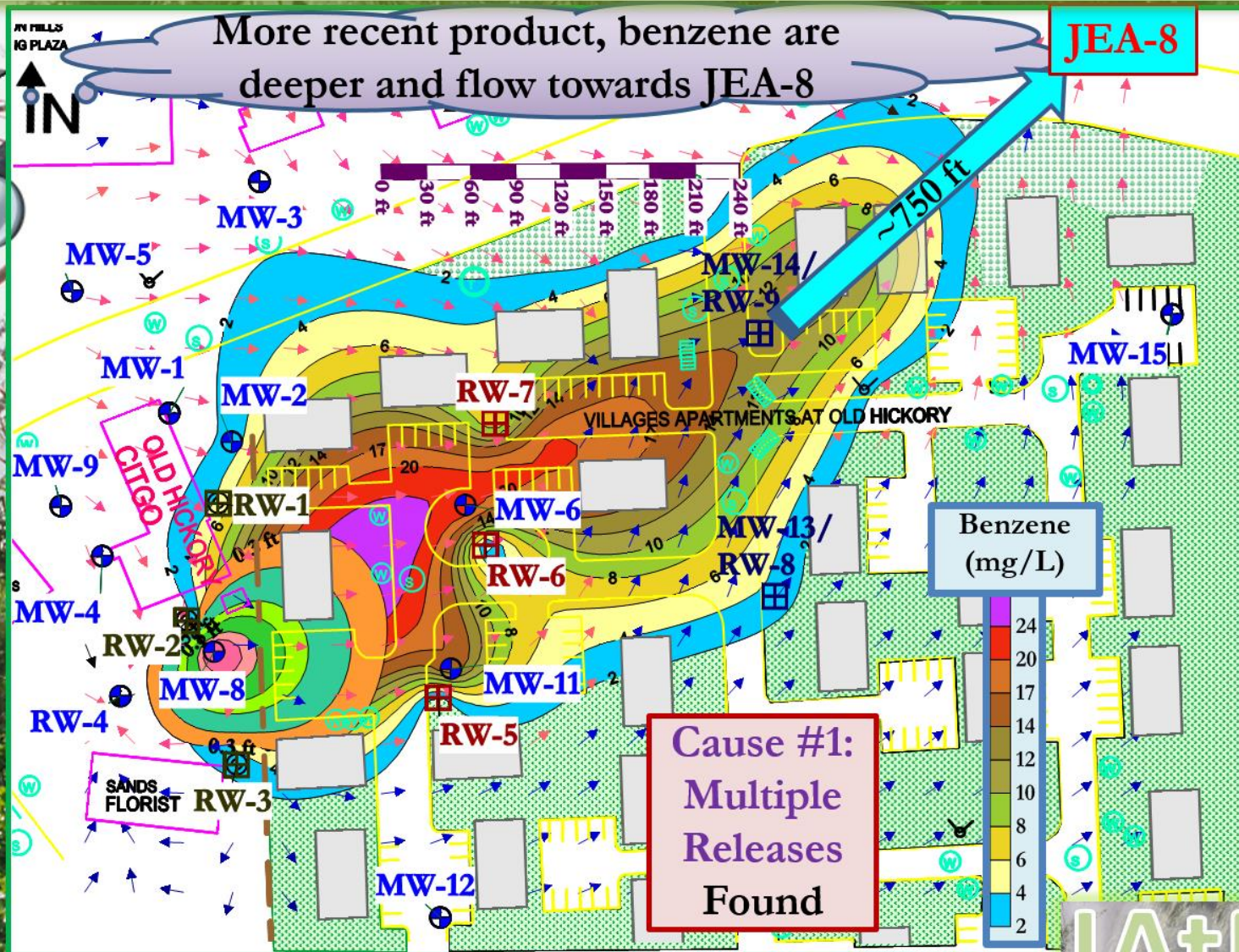
Asphalt Roadway

Old Hickory Citgo: Facility ID #8-570405 Jackson, TN



December
2015 flow
gradients

Product
(ft)



Cause #1:
Multiple
Releases
Found

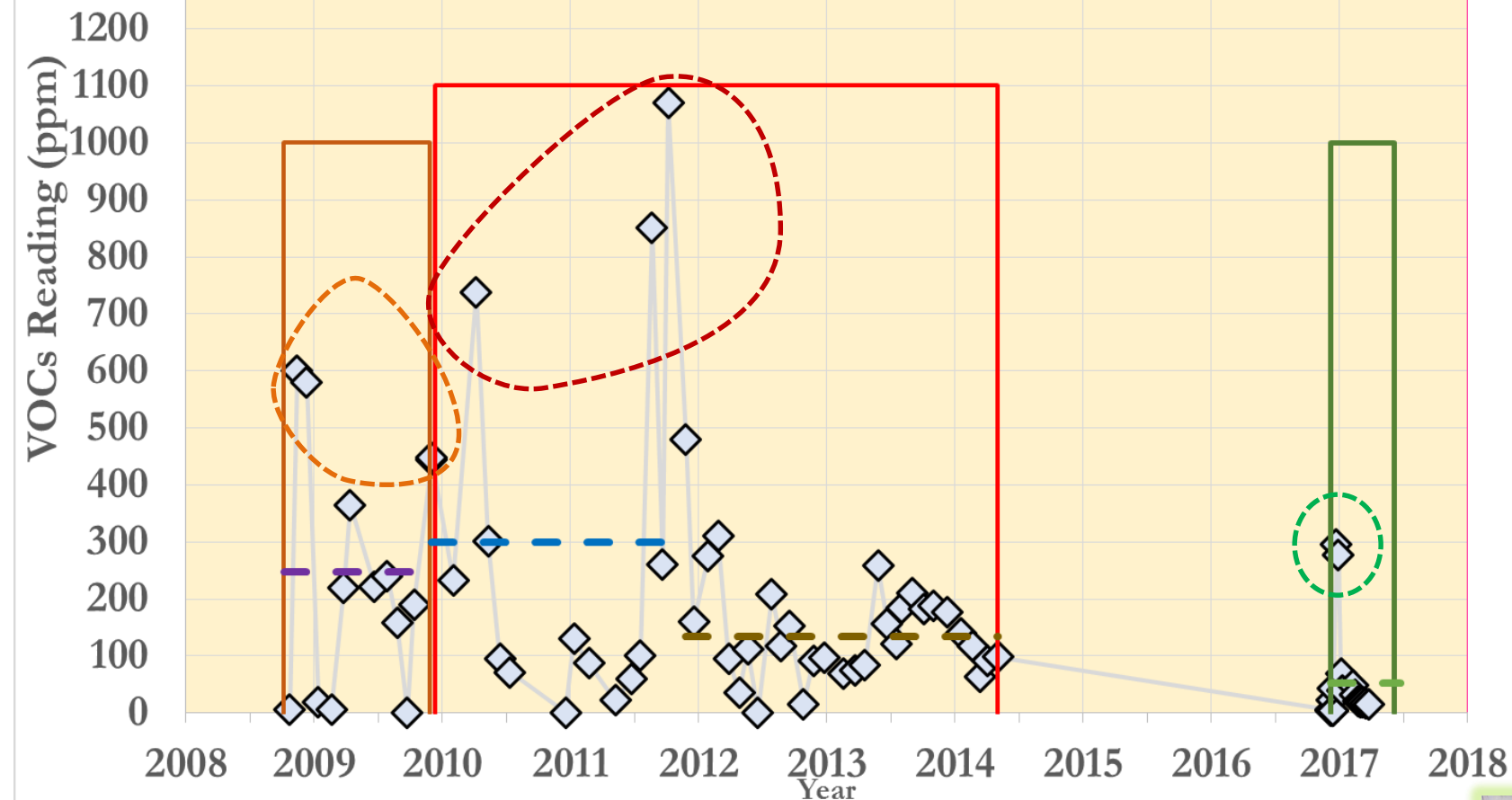
Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

SEE: Observed VOCs during Recovery



What is correlated to Higher Values?

- ◇ Emissions OVD reading (ppm)
- CAS 1 On: RW-1,RW-2, RW-3
- CAS 2 On: Adds RW-5,RW-6, RW-7
- CAS 3 On: 5 Off-site wells in grass
- Ave VOC CAS 1: 248 ppm
- Ave VOC CAS 2: 300 ppm
- Ave CAS 2 After Max: 134 ppm
- Ave VOC CAS 3: 52 ppm



Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

Transient Water Elevation Determination: Transforms Daily Stream Data Collected by USGS in Daily Estimates of DTW at Each Well

What are the suspects' motive?
Why has higher vapor recovery occurred?
Time to break out **TWED**!

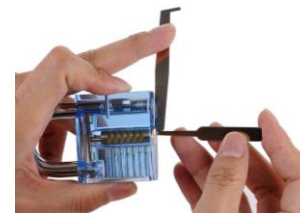
TWED - Not available anywhere else

IAtM

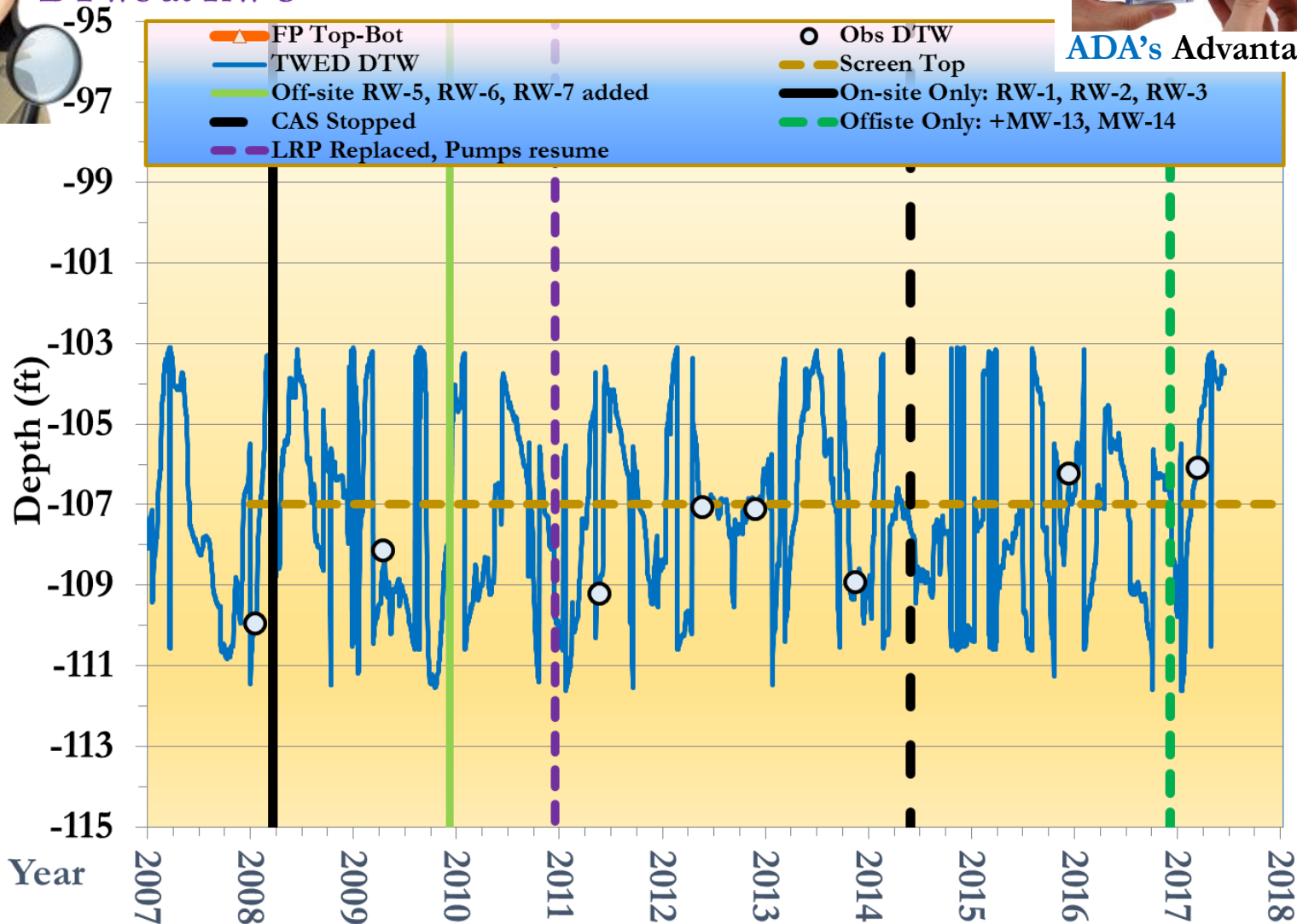


Translating river flow data
into DTWs for every day

TWED



DTWs at RW-3



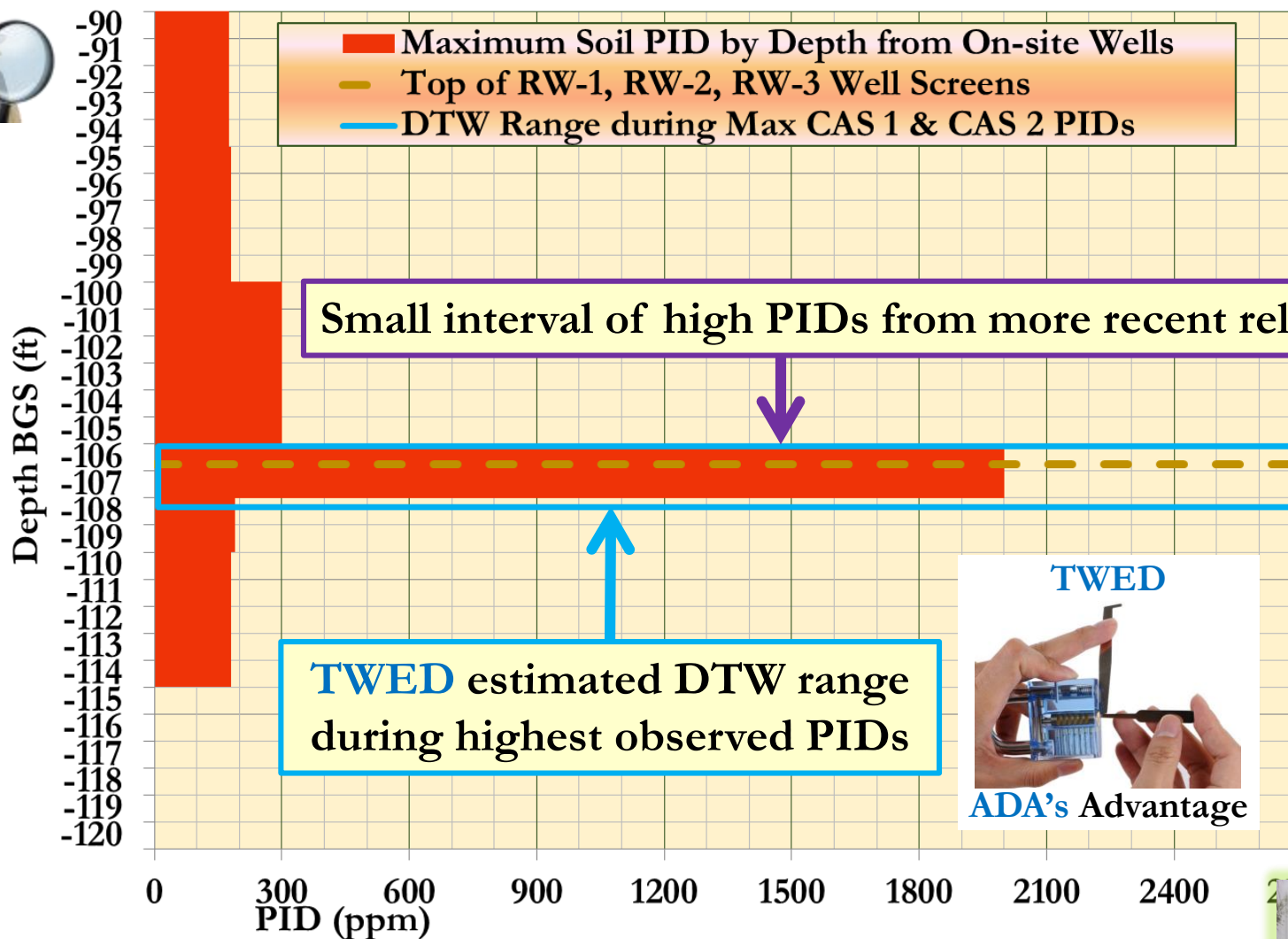
Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

SEE: Small Interval of Significantly Higher Soil PIDs Corresponds to DTW Range when Maximum VOCs Recovery Occurred **On-site (CAS 1 & CAS 2)**



Let's convert the soil PID data into a suspect profile...

Maximum Soil PID by Depth from On-site Wells



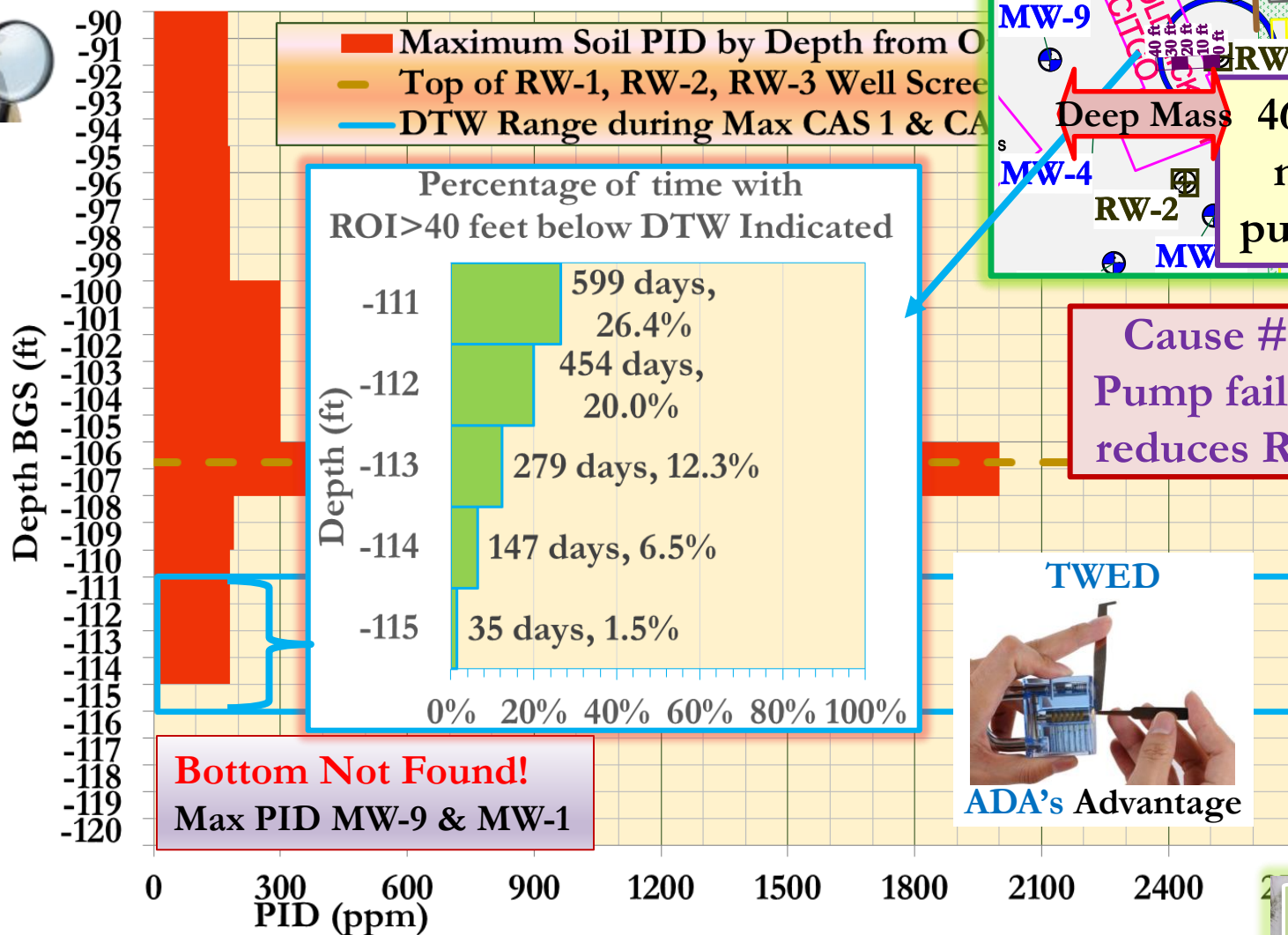
Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

SEE: Deeper Mass Indicated between RW-1 and MW-9 Not Frequently Exposed to Vapor Recovery: Incompletely Reduced Deeper Mass near RW-1 Possible



What is the probability of missed deep mass?

Maximum Soil PID by Depth from On-site Wells



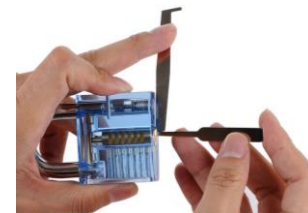
Old Hickory Citgo: Facility ID #8-570405
Jackson, TN



Can I find evidence of missed deep mass?
Will the concentrations rebound?

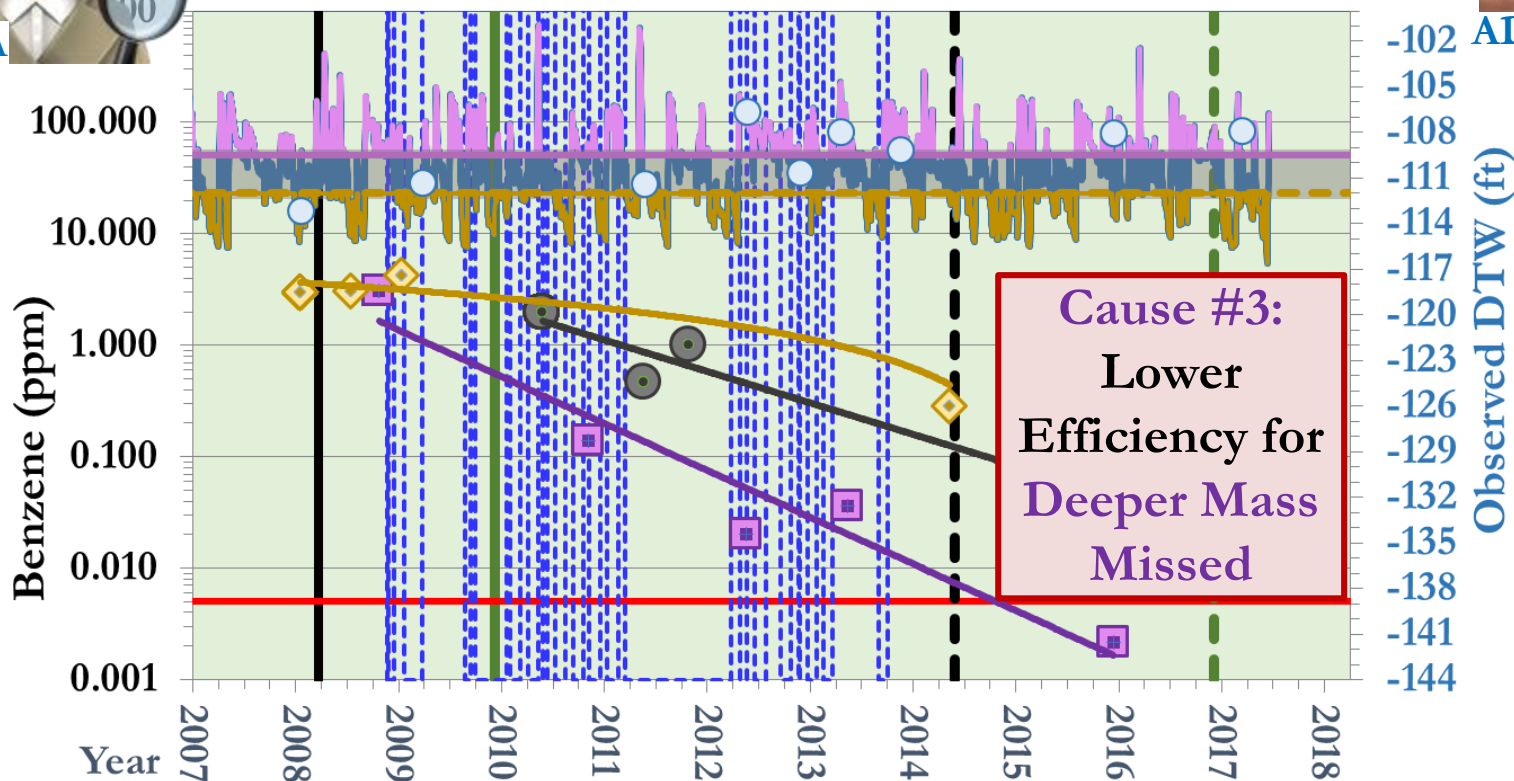
Yes!

TWED



ADA's Advantage

Benzene (ppm) at RW-1 Grouped by DTW



- Benzene: DTW < 109.5 ft
- ◆ Benzene: DTW > 112 ft
- On-site Only: RW-1, RW-2, RW-3
- Standard (0.005 ppm)
- Offsite Only: +MW-13, MW-14
- TWED DTW (ft)
- Upper DTW Threshold
- Lower DTW Threshold
- Obs DTW

- Benzene: DTW 109.5-112 ft
- ND det limit
- Off-site RW-5, RW-6, RW-7 added
- CAS Stopped
- RW-1 Pump off: ROI < 40 feet
- DTW Above Upper (ft)
- Middle DTW Range
- DTW Below Lower (ft)
- FP Top-Bot

Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

SEE: Frequency of Different ROIs for Off-site Recovery Wells Derived from Daily River Flow Data Shows Minimal Effective Off-site Vapor Recovery



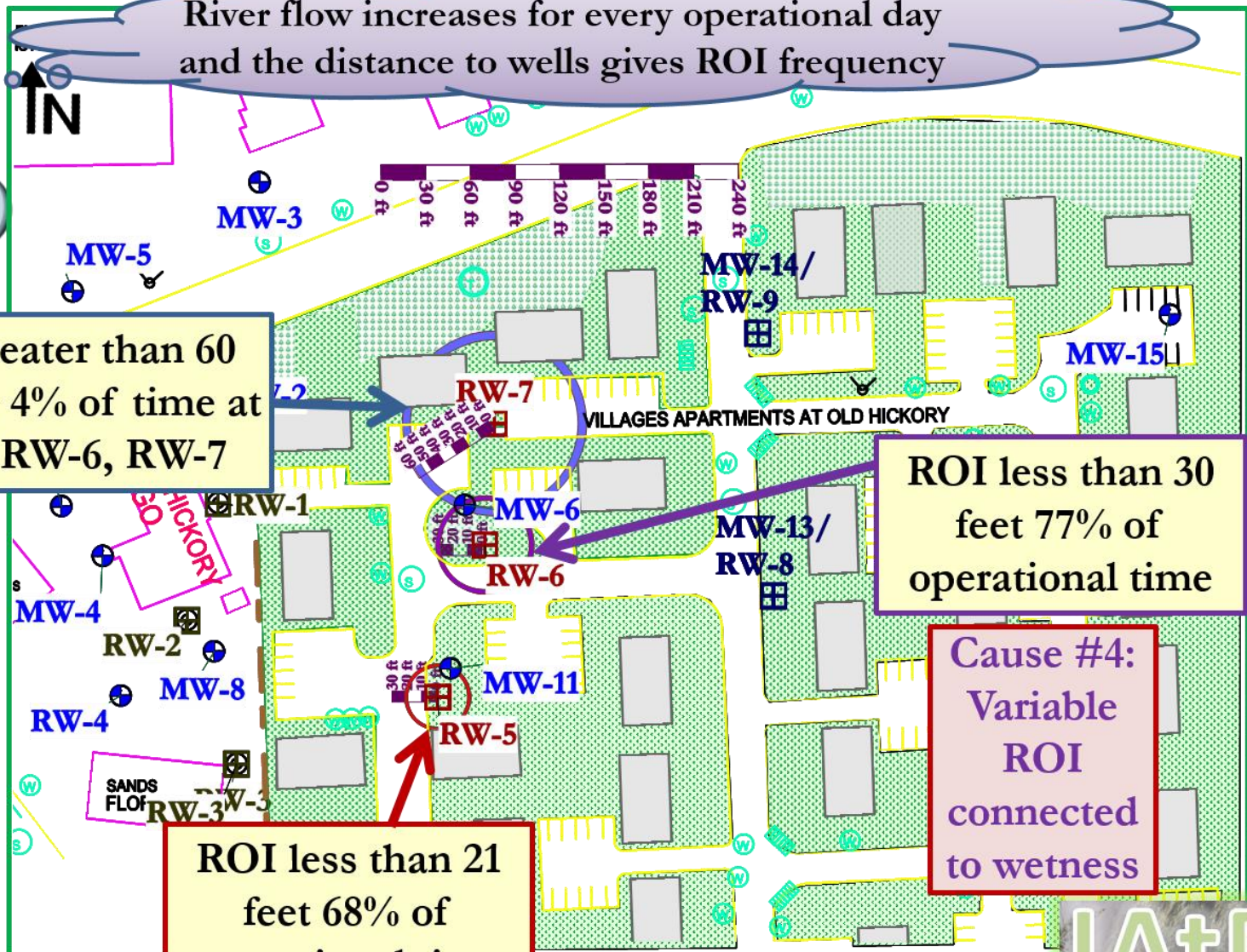
River flow increases for every operational day and the distance to wells gives ROI frequency

ROI greater than 60 feet only 4% of time at RW-5, RW-6, RW-7

ROI less than 30 feet 77% of operational time

Cause #4:
Variable
ROI
connected
to wetness

ROI less than 21 feet 68% of operational time



Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

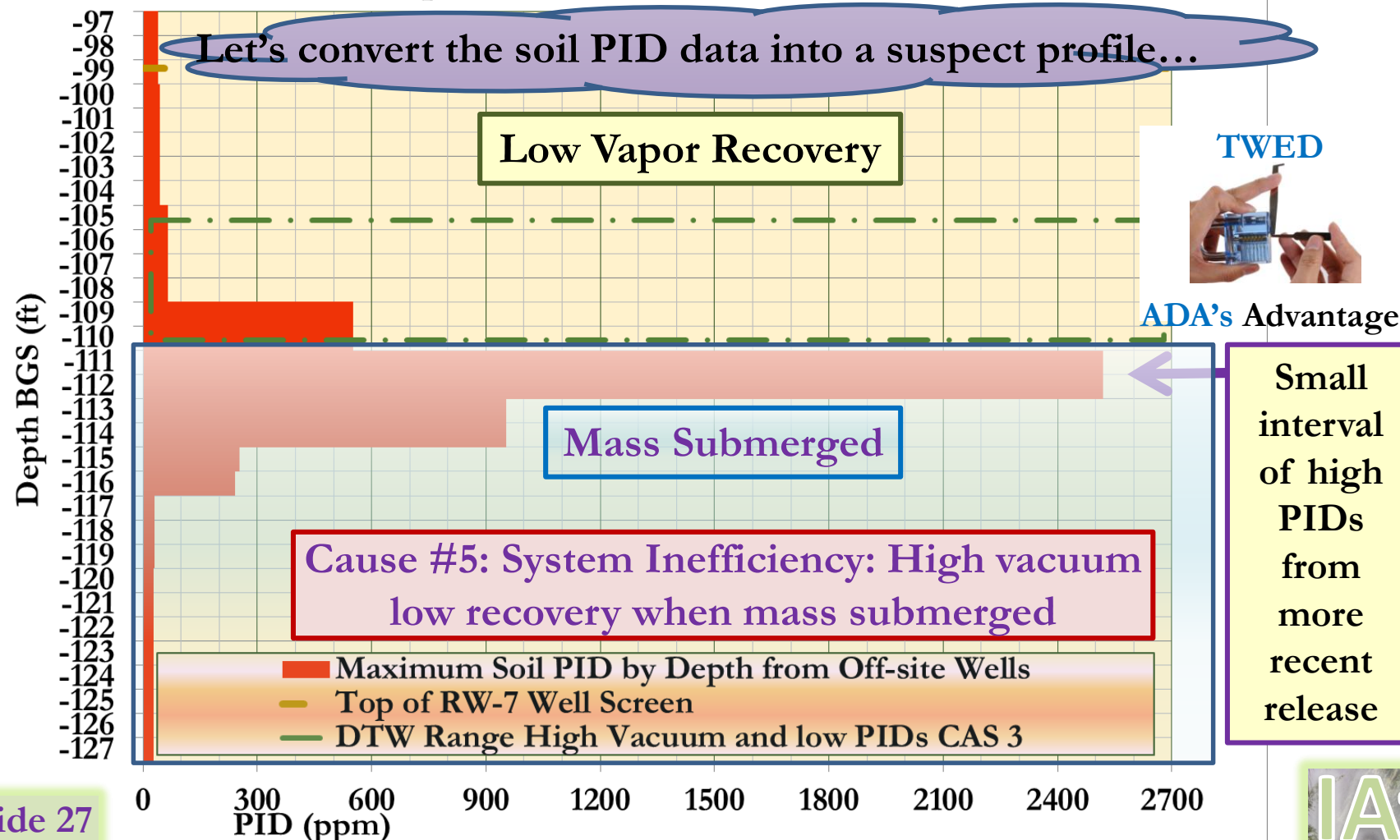
IAtM



Why low vapor recovery during high vacuum responses **Off-site** when CAS 3 Operating?

High Vacuum Responses (large ROIs) with River Increases

Maximum Soil PID by Depth from Off-site Wells



Old Hickory Citgo: Facility ID #8-570405
Jackson, TN



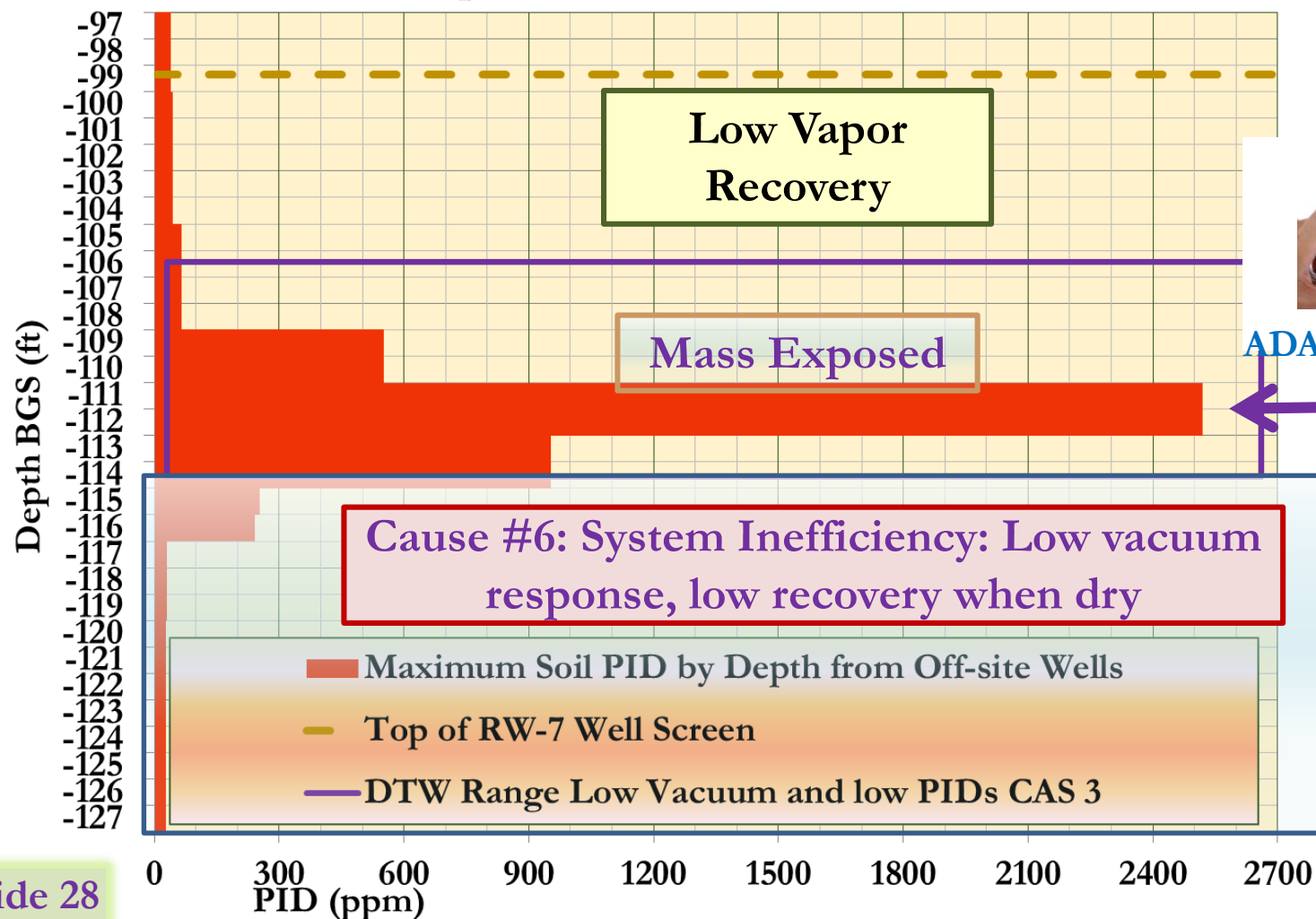


Why low vapor recovery when mass not submerged?

What has changed at our site?

Low Vacuum Responses (small ROIs) with dry conditions

Maximum Soil PID by Depth from Off-site Wells



TWED



ADA's Advantage

Small interval of high PIDs from recent release

Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

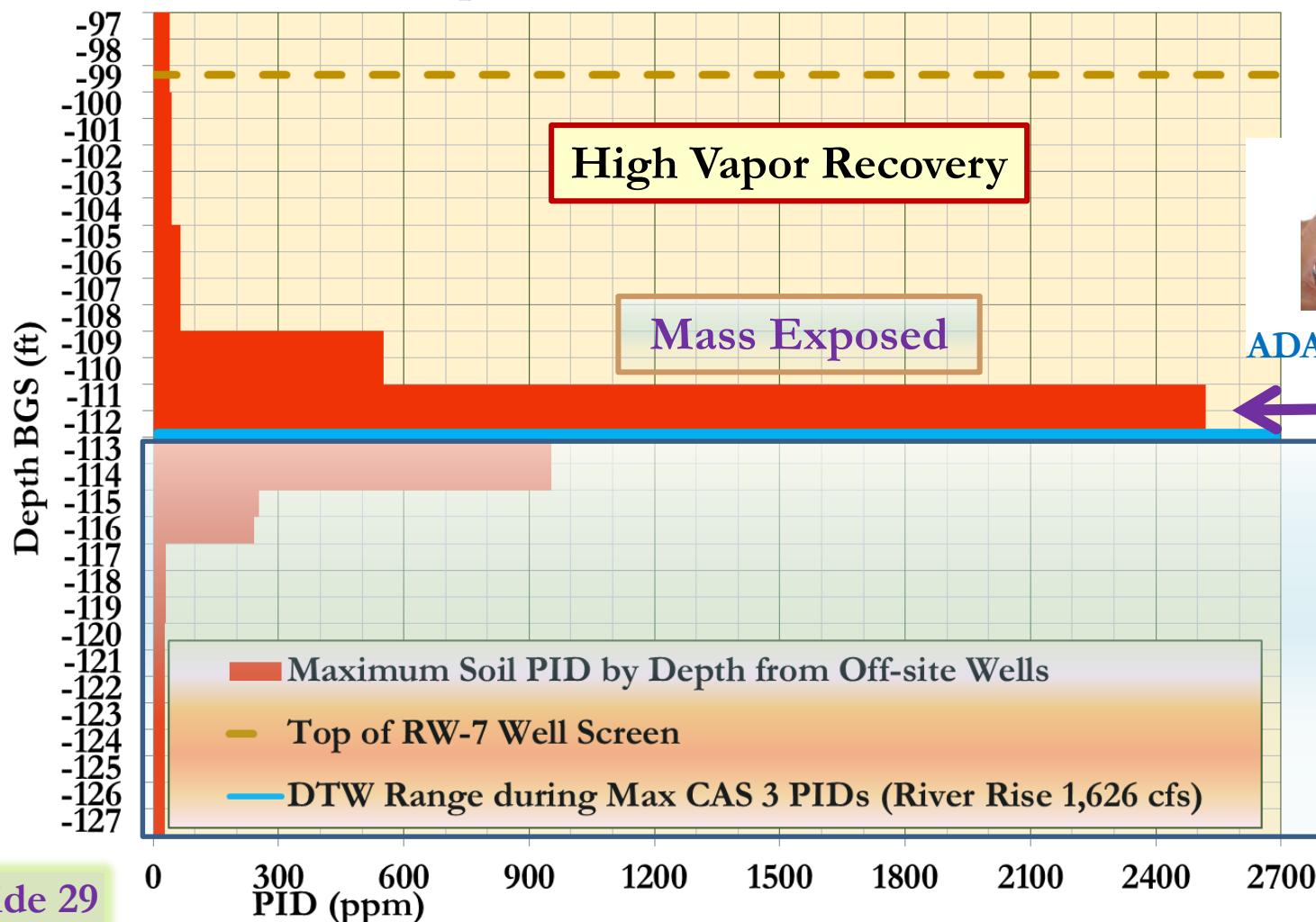




What cause the brief period of high vapor recovery?

High Vacuum Responses (large ROIs) with River Increases

Maximum Soil PID by Depth from Off-site Wells



TWED



ADA's Advantage

Small interval of high PIDs from more recent release

Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

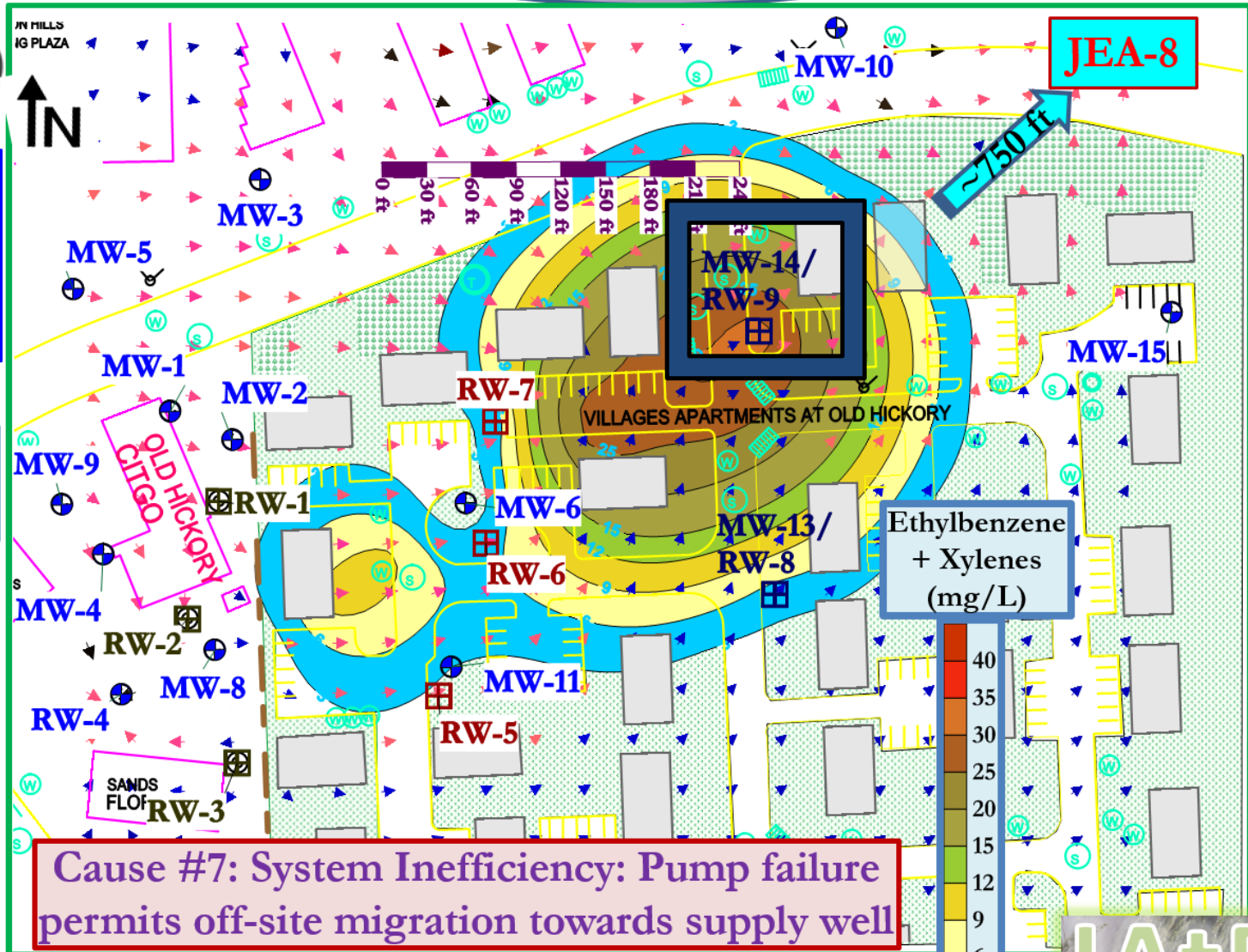
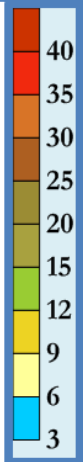




Let's combine flow directions and concentrations
Spatially with **SOURCE TRACKER**...

After 2015
No pump
flow
gradients

Ethylbenzene
+ Xylenes
(mg/L)



Cause #7: System Inefficiency: Pump failure
permits off-site migration towards supply well

Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

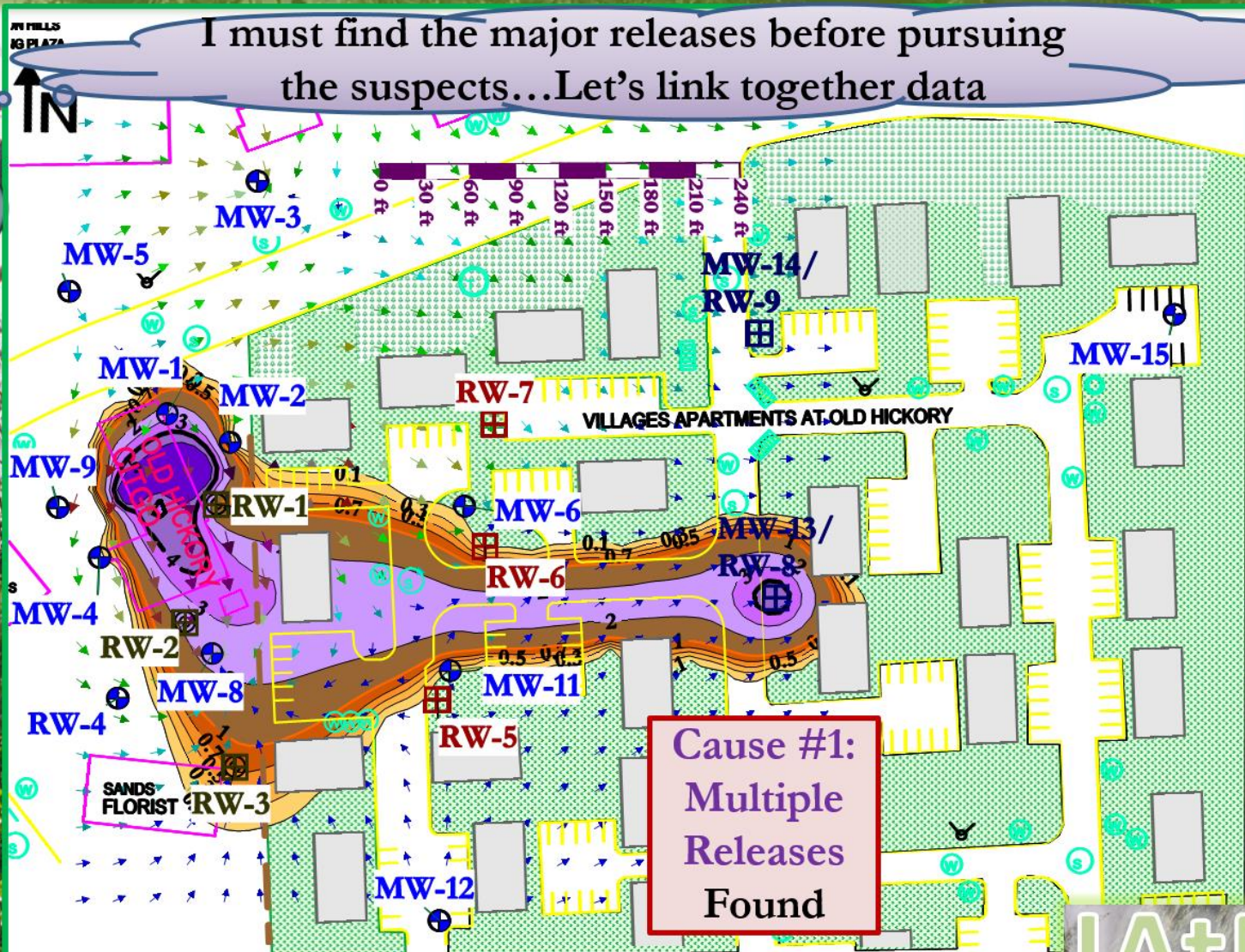
Old Hickory Citgo: Facility ID #8-570405 Jackson, TN



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October
2008 flow
gradients

Naphthalene
(mg/kg)



I must find the major releases before pursuing the suspects...Let's link together data

Cause #1:
Multiple
Releases
Found

Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

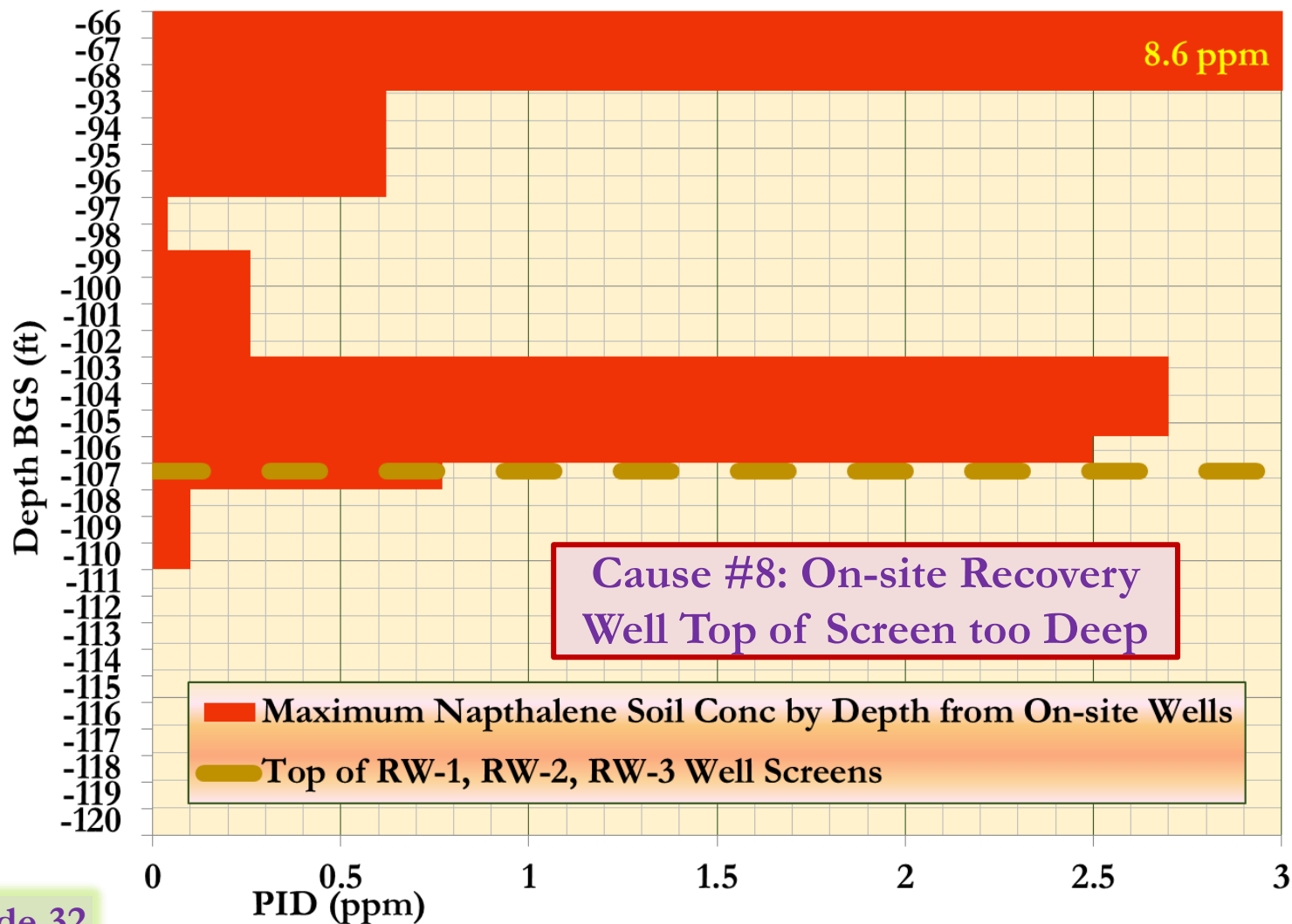
IAtM



Why are Shallow Naphthalene Concentrations High at RW-1?
How is the Naphthalene profile different than the others?

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Maximum Naphthalene Soil Conc by Depth from On-site Wells



Old Hickory Citgo: Facility ID #8-570405
Jackson, TN



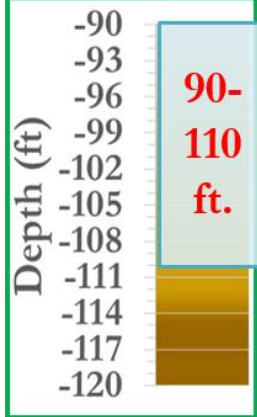
Time for **SOURCE LOCATOR** to bring it all together and find the mass that was missed

2012 Extent of Shallow Mass in Upper Layer
(Normalized Depths of 90 to 110 feet)

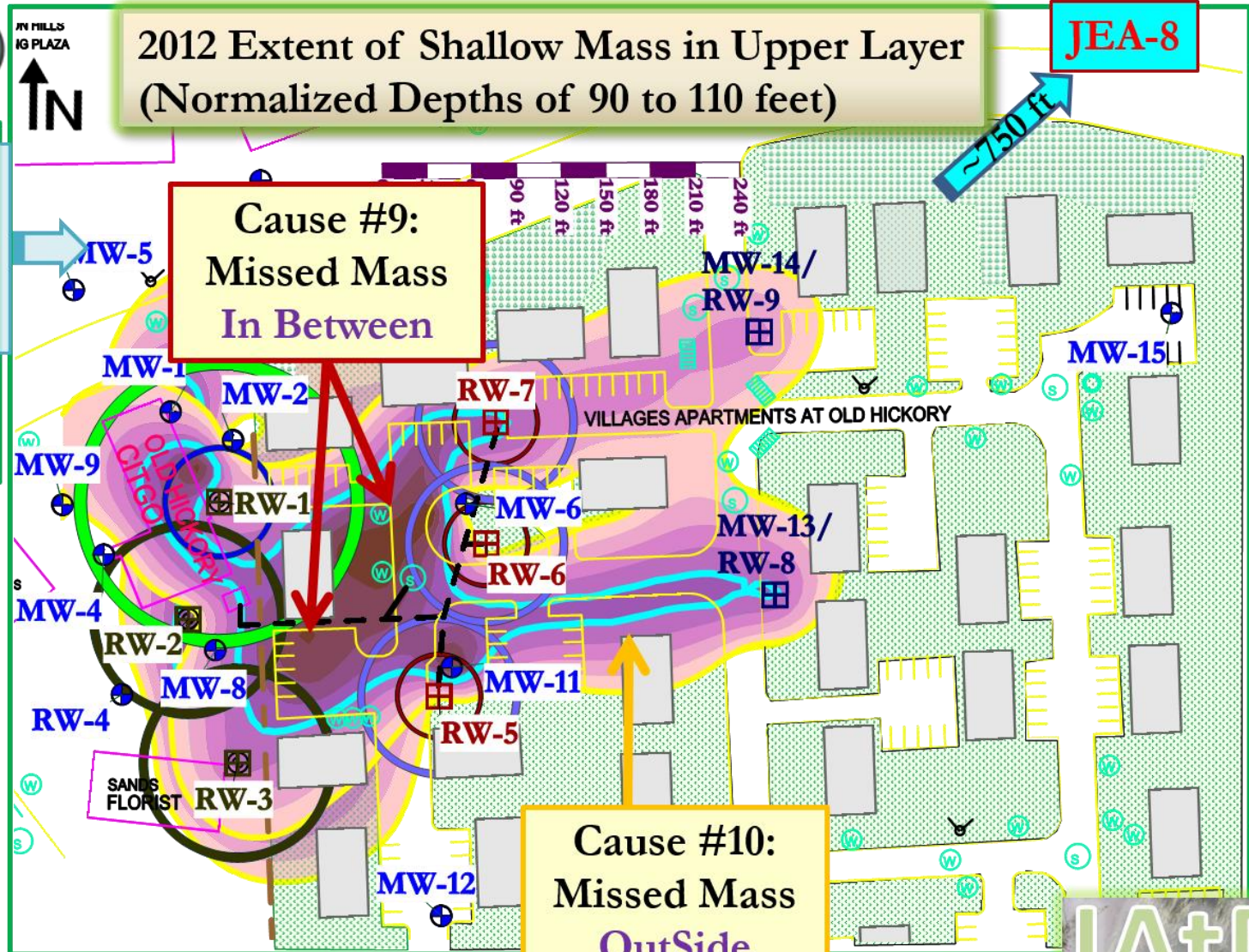
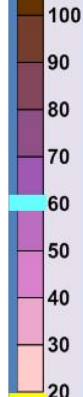
JEA-8

**Cause #9:
Missed Mass
In Between**

**Cause #10:
Missed Mass
OutSide**



P_w (%)

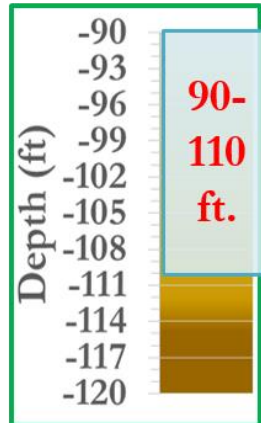


Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

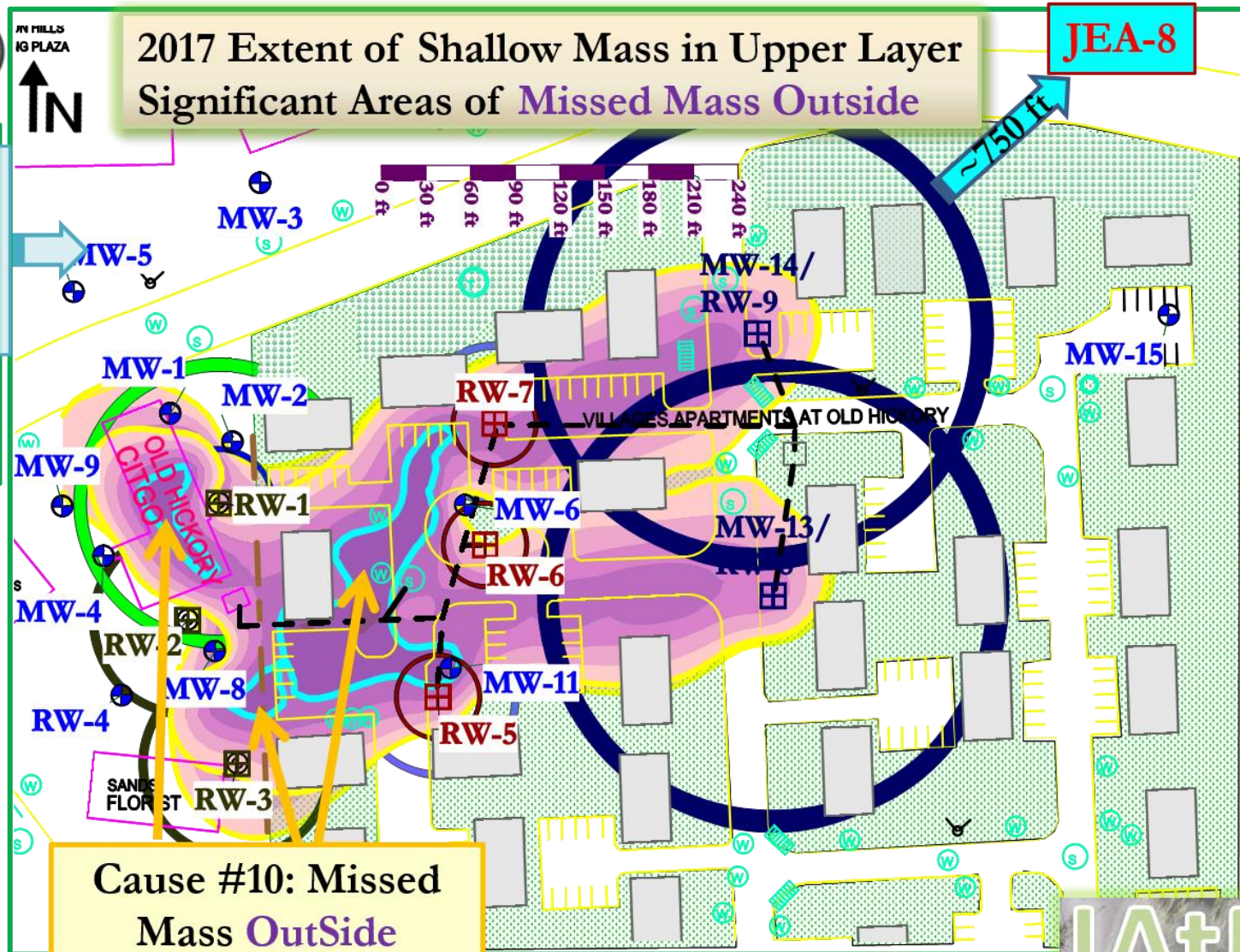
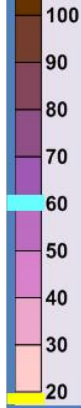
IAtM



Time for **SOURCE LOCATOR** to bring it all together and find the mass that was missed



P_w (%)

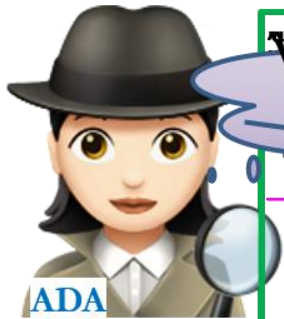


Cause #10: Missed Mass Outside (mostly naphthalene)

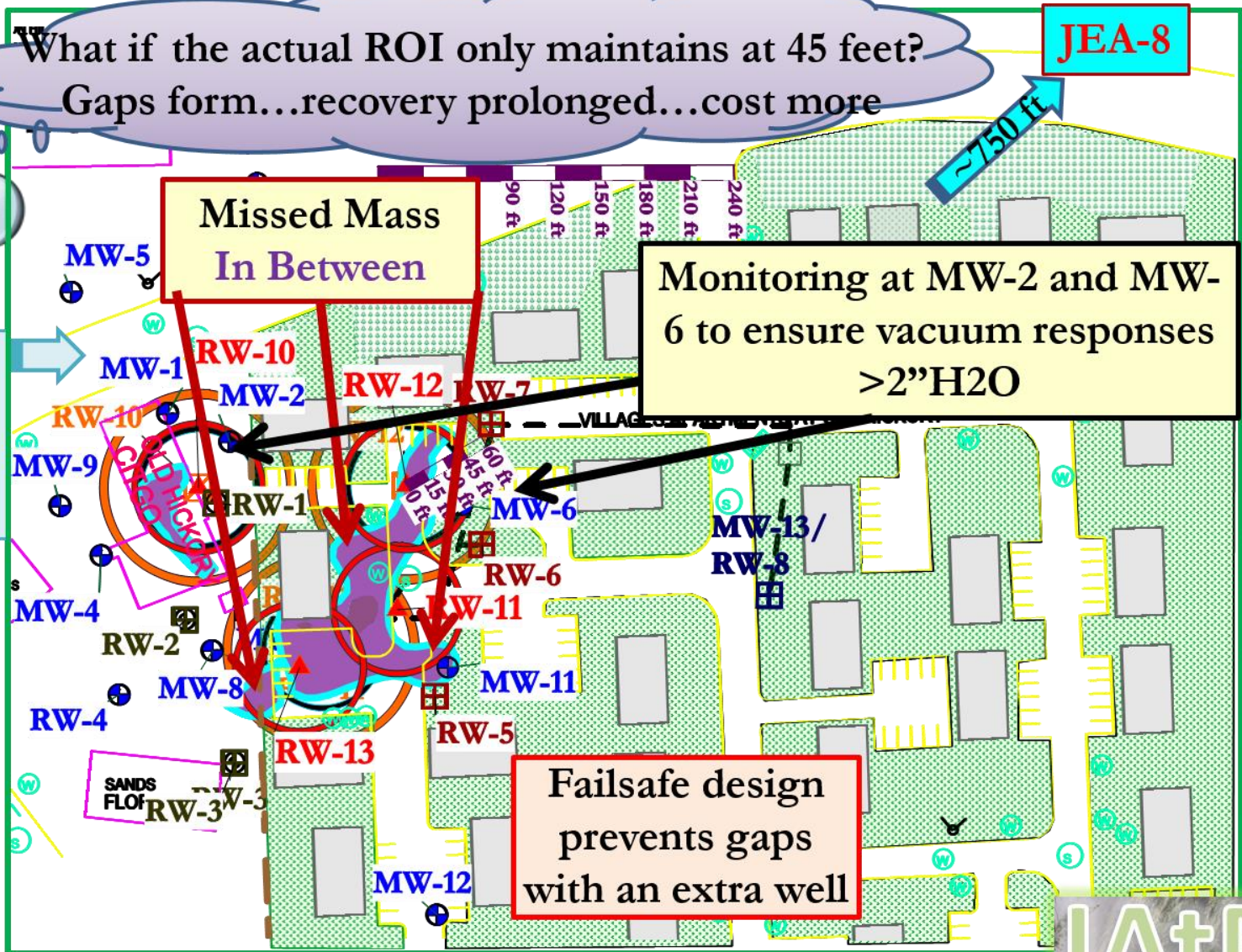
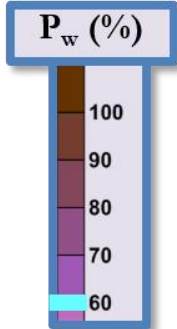
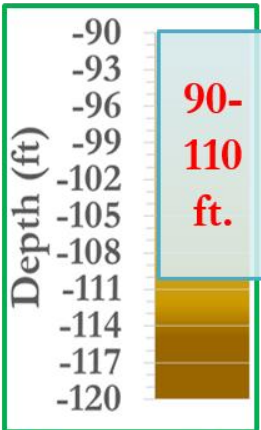
Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

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Necessary Suggestion: One On-site Recovery Well with Shallower Screen and Two Off-site Recovery Wells in Paved Areas Needed to Reduce Shallow Mass



What if the actual ROI only maintains at 45 feet?
Gaps form...recovery prolonged...cost more



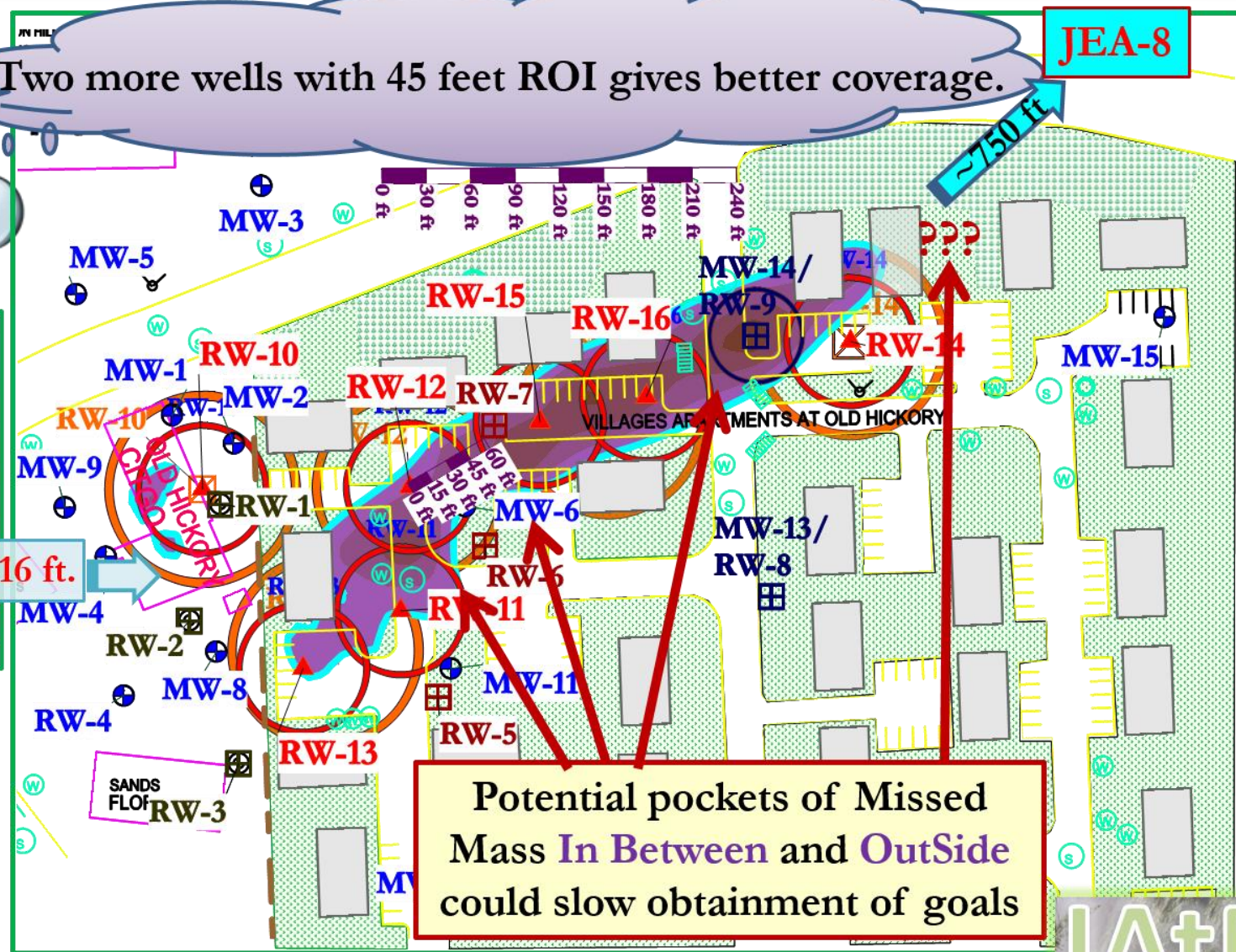
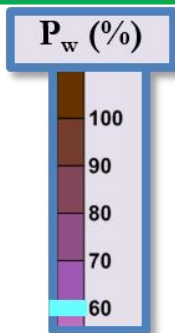
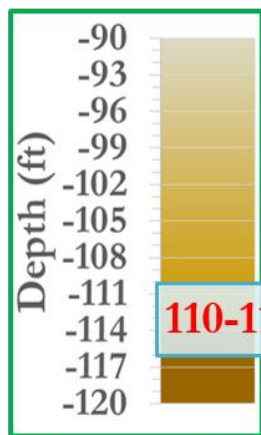
Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

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Optional Suggestions: Fail safe Design adds Two More Off-site Recovery Wells in Paved Areas to Better Cover Missed Mass with 45 feet ROI

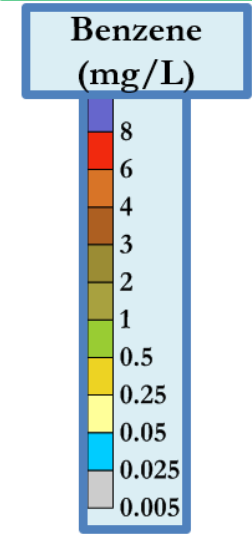


Two more wells with 45 feet ROI gives better coverage.



Old Hickory Citgo: Facility ID #8-570405
Jackson, TN

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The map displays the JEA-8 site with various monitoring wells (MW-1 to MW-16) and recovery wells (RW-1 to RW-15). A pink box highlights a specific area with a callout: "Paving areas where existing recovery wells". An inset photograph shows a street view of the area. The map also labels "VILLAGES APARTMENT" and "OLD LOCKERY".

Old Hickory Citgo: Facility ID #8-570405
Jackson, TN



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If possible extending the pavement by RW-9 could quickly restore its ROI and accelerate obtainment of remedial goals...



Extending parking lot pavement could quickly improve MW-14/RW-9 ROI

Optional Suggestions

Goggle Earth

IAtM

